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ARCHIVES OF OTOLARYNGOLOGY

VOLUME 6 DECEMBER, 1927 NUMBER 6

RETROBULBAR NEURITIS AND INFECTION OF THE ACCESSORY NASAL SINUSES*

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Acute neuritis of the optic nerve may be due to any one of the following conditions: (1) syphilis; (2) tuberculosis; (3) the acute infectious diseases—including erysipelas, mumps, influenza, tonsillitis, measles, pneumonia and malaria; (4) toxic conditions—caused by disease of the kidneys, extensive skin burns, methyl alcohol, the excessive or long continued use of quinine, salicylates, iodoform, arsenic, tobacco, ethyl hydrocuprein and, rarely, carbon monoxide; (5) multiple sclerosis; (6) infection of the accessory nasal sinuses. In each of these conditions there is a stage in which the inflammatory process may be confined to the optic nerve posterior to its entrance into the eye, and little may be learned from inspection of the eyegrounds. Later, the changes in the papillomacular bundle may cause a wedged-shaped area of pallor on the temporal side of the disk.

The nerve fibers and interstitial connective tissue that make up the papillomacular bundle are the parts of the optic nerve involved in the early stages of retrobulbar neuritis, and therefore an enlargement of the blind spot, with an absolute central scotoma for color and form, together with a marked loss of visual acuity, constitutes the earliest objective evidence of retrobulbar neuritis. As the inflammation progresses, the edema and cellular infiltration of the nerve trunk may result in absolute blindness. Vision may return to normal as the edema in the nerve subsides or may only improve temporarily, regression occur and blindness become permanent owing to secondary optic atrophy. The duration of the inflammatory process in the nerve is of prime importance, and although a thorough diagnostic study of the patient is necessary, no time should be lost in opening the posterior group of sinuses if they are infected.

Infection of the accessory nasal sinuses is one of the common causes of retrobulbar neuritis. On the other hand, only a small percentage of patients with infection of the sinuses have a retrobulbar neuritis as a

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complication. A possible explanation of this fact is suggested by the anatomic and embryologic studies of Onodi, Schaeffer and Warren B. Davis. The posterior group of sinuses develop by an absorption of bone, and a great variation exists in the size of the sinus cavities, in the thickness of the bony wall that separates the sinus from the nerve and in the relation of the posterior ethmoidal and sphenoidal sinuses to the optic nerve. The Onodi collection that is now in the Royal College of Surgeons in London and the Schaeffer collection in Philadelphia contain anatomic specimens in which the optic nerve is separated from the posterior ethmoidal or sphenoidal cells by the thinnest layer of bone or by mucous membrane alone.

Anatomic variations may also explain unilateral visual disturbances when the infection of the sinuses is limited to the posterior group on the opposite side, or involvement of both optic nerves from an infection of the posterior ethmoidal or sphenoidal sinus on one side. Dissections in the London collection demonstrate the following relations of the optic nerves to the sinuses:

1. The left posterior ethmoidal cell forms the medial wall of the canalis opticus on the right.

2. The right posterior ethmoidal cell forms the lower and medial wall of the canalis opticus on both sides and the wall of the entire sulcus opticus.

3. The left sphenoidal sinus forms the lower walls of the canalis opticus on the right.

4. The left sphenoidal sinus forms the lower and medial wall of the canalis opticus on both sides and the wall of the entire sulcus opticus

5. Thrombophlebitis and other circulatory disturbances in the optic nerve may result from the anastomosis of the ethmoidal veins with the plexus ophthalmicus and the venous plexus in the dura.

An explanation of the occurrence of retrobulbar neuritis secondary to a more distant focus of infection, such as infections of the genito-urinary tract, acute and chronic tonsillitis and apical infection of a tooth, is that the optic nerve in some persons is especially susceptible to circulating toxins. Concerning the diagnosis of infection of the sinuses in these cases in which the eyes showed complications, it should be emphasized that the other conditions mentioned may also be responsible for the visual disturbance. We have not found it difficult to recognize an infection of the posterior ethmoidal or sphenoidal sinus, but irreparable damage may result if the laryngologist or the ophthalmologist assumes that an infection of the sinuses is responsible for the visual disturbance and fails to eliminate every other possible cause. It will be brought out in the case histories and in photographs of mucous membrane removed at operation from patients with retrobulbar neuritis that the diagnosis of infection of the sinuses does not depend on the demonstration of a discharge in the nose or the presence of polypi around the

orifice of the sinuses. In many of our cases, the inflammatory process in the mucous membrane of the affected sinus was limited to a cellular infiltration with eosinophils and plasma cells; the lining epithelium was intact, and discharge could not be demonstrated with suction or lavage. In every patient who did not have a gross discharge, however, a localized hyperemia of the mucous membrane around the orifice of the affected sinus could be seen with a nasopharyngoscope, provided care was taken not to use cocaine or epinephrine in this area before the examination. Unless there is evident infection of the sinuses or the loss of vision is progressing rapidly, it is never justifiable to operate on the sinuses until the patient has been subjected to a thorough diagnostic study.

The following case reports are all examples of a retrobulbar neuritis that apparently developed as a result of infection in the accessory nasal sinuses. In each of these cases, however, the patient was admitted to the hospital and was subjected to a thorough diagnostic study in order to eliminate the other common causes of retrobulbar neuritis, and to search for foci of infection in the teeth, tonsils, genito-urinary tract, appendix, gallbladder and large intestine. In this selected group of cases, an infection in the upper respiratory passages was the only apparent cause for the lesion in the eyes, and in order to avoid repetition, only the important data with a bearing on the diagnosis are included in each history.

REPORT OF CASES

CASE 1.—*History.*—A white woman, aged 43, single, was admitted to the hospital in June, 1922, complaining of frontal headache, frequent attacks of acute coryza and impairment of vision in the right eye. The headache was located across the forehead and was not limited to one side. The history of frequent colds in the head dated from an attack of influenza two years previously. The impairment of vision was first noticed three weeks prior to admission and was not associated with an acute coryza or other illness. With the exception of slight tenderness over and behind the right eye, there were no other symptoms.

Examination.—The left eye was normal. The visual acuity was 20/15. The right eye looked normal externally. Visual acuity was 10/50 with glasses. The fundus looked normal, with the exception of a slight congestion of the capillaries in the nerve head. The visual fields were normal on the left, but showed a concentric contraction of 20 degrees for form and 10 degrees for color, with a definite central scotoma for red (fig. 1).

The teeth were normal on examination and roentgenographically. There was no evidence of a chronic tonsillitis. The breathing space through the nose was normal, and signs of an infection of the accessory nasal sinuses, other than a localized hyperemia of the mucous membrane around the posterior end of the middle turbinate on the right, were not present. There was no chronic infection in the nasopharynx.

Neurologic and other examinations were negative.

Therapy.—Under local anesthesia, the posterior half of each middle turbinate was removed, and the posterior ethmoidal and sphenoidal sinuses on both sides were opened widely. No discharge was seen in any of the sinuses, and the

membrane lining the sinuses was everywhere normal, with the exception of that in the posterior ethmoidal cells on the right. These cells were extensive, and the lining membrane was definitely thickened. This thickened mucous membrane was removed, but that lining the other sinus was left in place.

Subsequent Course.—Postoperative infection was not seen in the sinuses that were opened. One week after the operation, the visual acuity in the left eye was 20/15 (the same as before the operation) and in the right eye 20/15 (it was 10/50 before operation). Vision has remained normal subjectively, and the visual acuity and the visual fields have been normal objectively during the past five years. The frontal headache, which had been present for two years, ceased soon after the operation. The histologic changes in the mucous membrane removed from the posterior ethmoidal cells on the right are shown in figure 2.

Comment.—The sudden onset of a visual disturbance in one eye; the absence of changes in the fundus, besides hyperemia; the central scotoma for color; the

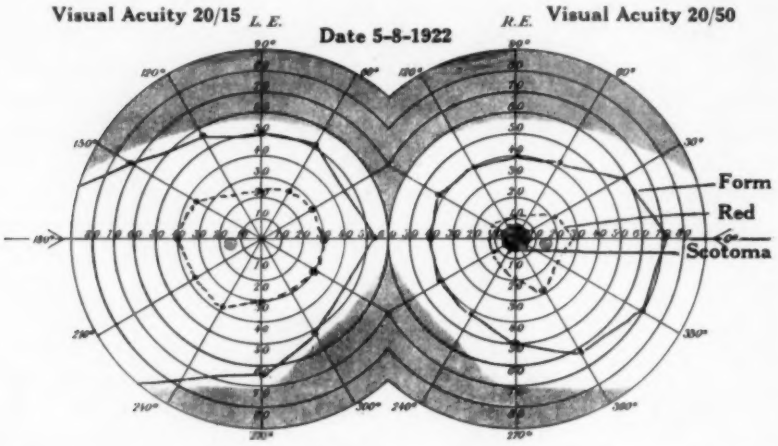

Fig. 1 (case 1).—Visual fields before operation. The contraction of the field for form and color on the left, and the central scotoma for color should be noted.

history of frontal headache and recurring attacks of coryza that dated from an attack of influenza two years previously; the negative results of a complete history and a diagnostic study for other causes of the optic neuritis, and the prompt and permanent cure after the operation on the sinuses make it seem likely that the infection of the sinuses was the cause of the visual disturbance in this patient. In these cases, the slight but definite hyperemia of the mucous membrane near the orifice of the affected posterior ethmoidal sinuses will be overlooked if the nose is sprayed with cocaine or epinephrine preliminary to the examination, and is best seen if the posterior nares are examined with a nasopharyngoscope.

Case 2.—*History.*—A white woman, aged 48, married, was admitted to the hospital in November, 1920. The only illnesses noted in the past history were scarlet fever and acute nephritis at the age of 12. For the past twenty years, her general health had been excellent. The severe frontal headache dated from an attack of influenza nine months before admission and had continued almost without remission. Transient edema of the eyelids and diplopia had been asso-

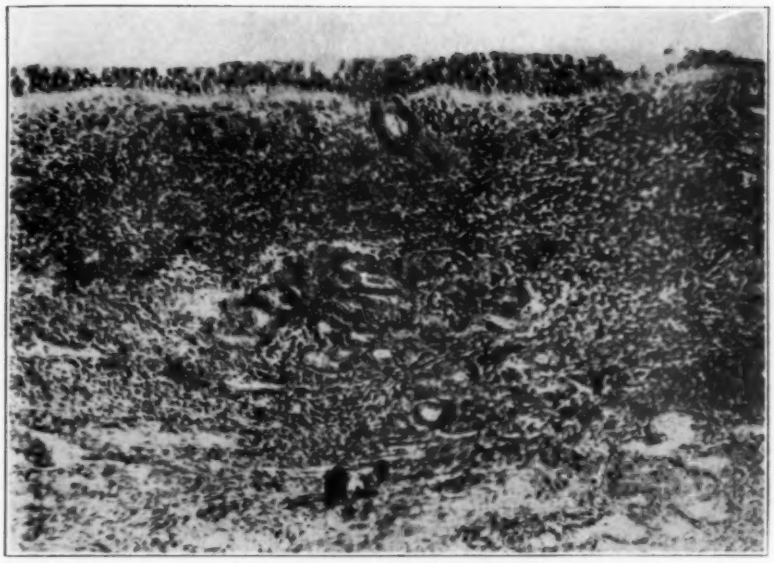

Fig. 2 (case 1).—Appearance of mucous membrane removed from the posterior ethmoidal cells on the right. The surface epithelium is intact. The mucous membrane is thickened, due to infiltration with inflammatory cells.

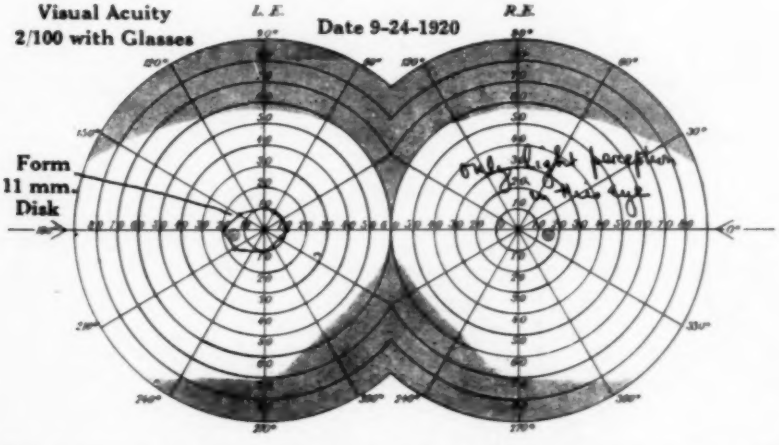

Fig. 3 (case 2).—Visual fields before drainage of the infected sinuses. This illustration should be compared with the examinations made after the operation on the sinuses (fig. 4).

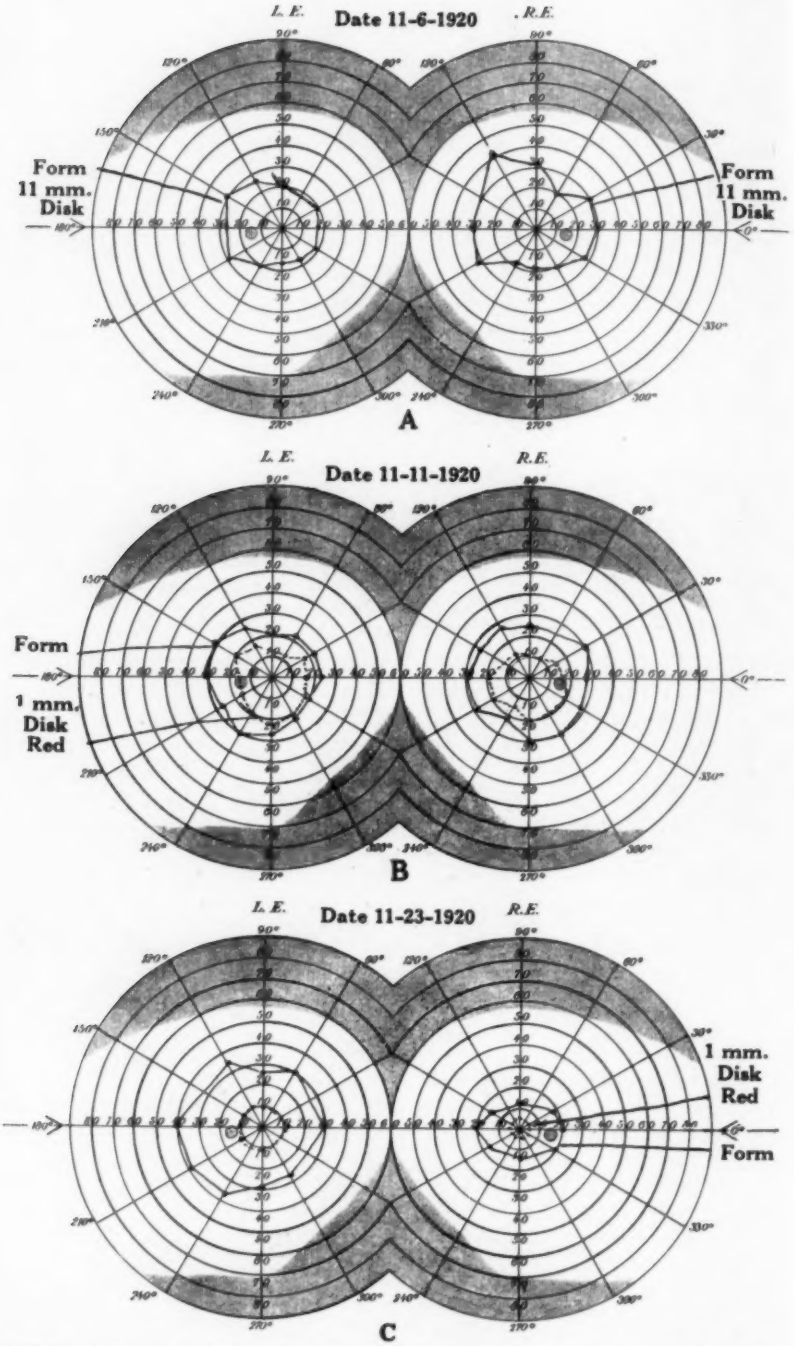

Fig. 4 (case 2).—Appearance of visual fields after operation. The visual fields in figure 3 and *A* were made with a 11 mm. white disk, and the remaining two (*B* and *C*) with a 1 mm. white disk. Two years later, the patient had useful vision in both eyes.

ciated with increased severity of the headache on several occasions. The impairment of vision dated from the attack of influenza nine months previously, but during the past month had rapidly grown worse.

Examination.—Only light perception was present in the right eye; the patient could not count the fingers. Vision in the left eye was 2/100 with glasses. The perimetric field is shown in figure 3. Ophthalmoscopic examination showed marked pallor on the temporal side of both disks, but otherwise no changes were present.

There was a discharge from the region of the posterior ethmoidal sinuses on both sides. Polypi were present above the posterior end of the middle turbinate on the left. The frontal and maxillary sinuses were clear on transillumination and roentgenographically. The tonsils or teeth were not infected.

Results of the neurologic and general examinations were negative, as were those of examinations of the blood and the spinal fluid.

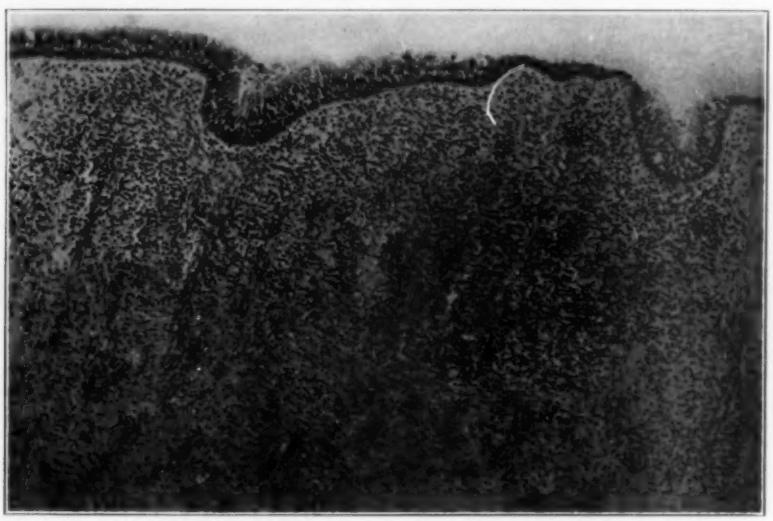

Fig. 5 (case 2).—Appearance of mucous membrane removed from posterior ethmoidal cells. The surface epithelium is intact. The mucous membrane is thickened, due to myxomatous degeneration and infiltration by round cells. The blood vessels are dilated.

Therapy.—Both middle turbinates were removed. Infection was not found in the anterior ethmoidal cells, but pus and polypi were present in the sphenoidal and ethmoidal cells on both sides. The histologic appearance of the tissue removed at operation is shown in figure 5.

Subsequent Course.—The series of perimetric charts (fig. 4) show the extent and rapidity of the improvement. On the third day after operation, the patient could read ⅜ inch type with the right eye at the normal distance without glasses. Using both eyes without glasses she could read from ⅛ to 3/16 inch type at the normal distance. With the right eye alone, she could tell the time correctly from a watch 5 feet away. Although the visual fields rapidly increased and then contracted somewhat, the patient still had useful vision (she could read and sew) when last seen two years later.

Comment.—The roentgen ray and transillumination were of no value in locating the infection of the sinuses in this case. The headache was severe and was located across the forehead and behind the eyeballs. There was a history of transient swelling of the upper lids and diplopia, but no tenderness on percussion over the frontal sinuses. The discharge was not abundant, and flowed backward into the nasopharynx.

The headache disappeared immediately after the infected posterior ethmoidal and sphenoidal sinuses were opened and never recurred. Vision improved rapidly after operation, but the infection in the optic nerves was of such long standing that many of the fibers were permanently destroyed by secondary atrophy.

Fig. 6 (case 3).—Appearance of mucous membrane removed from posterior ethmoidal cells. This infection dated from scarlet fever three months previously. Vision was 4/200 before operation, and was normal on the ninth day after operation.

CASE 3.—*History.*—A white boy, aged 9, was brought to the outpatient department in July, 1923, complaining of loss of vision. The onset dated from an attack of scarlet fever three months previously. The loss of vision was gradual and affected both eyes equally. The patient did not complain of headache. There was no history of frequent colds for several years.

Examination.—The eyegrounds looked normal. There was concentric contraction of the visual field in each eye and only a small area of central vision for a 2 mm. white disk. No scotoma was found. The right eye showed a visual acuity of 4/200; the left eye, of 4/200.

A large mass of adenoids was present. The tonsils were enlarged and infected. The glands at the angle of the jaws and in the posterior triangles were enlarged.

The teeth were in good condition. There was a purulent discharge from both sides of the nose. The frontal and maxillary sinuses were clear roentgenographically and on transillumination (fig. 7).

Results of the Wassermann and the tuberculin tests and of the neurologic and general examinations were negative.

Therapy.—The tonsils and adenoids were removed. The posterior halves of both middle turbinates were removed and the posterior ethmoidal and sphenoidal sinuses opened. Pus was present in these cells on both sides. The appearance of the infected lining of these cells is shown in figure 6.

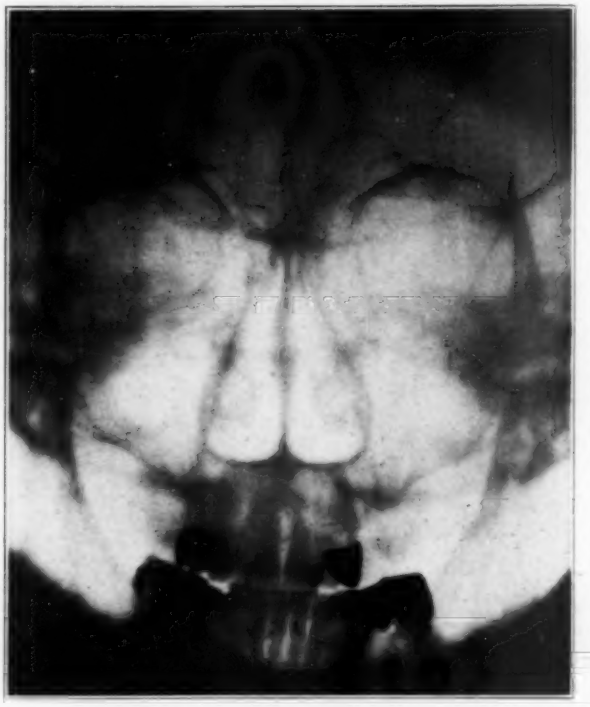

Fig. 7 (case 4).—Although the frontal and maxillary sinuses are clear roentgenographically, this patient had a purulent discharge from the posterior ethmoidal and sphenoidal sinuses on both sides.

Subsequent Course.—The visual acuity was 20/20 in each eye on the ninth day after operation, and the fundus looked normal. This patient was not seen after he left the hospital.

CASE 4.—*History.*—A white woman, married, aged 47, was admitted to the hospital in January, 1924, complaining of headache across the forehead, behind the eyes and in the back of the head; it was worse on the right side, and failing vision was present in the right eye. The general health had been poor for several years. Hysterectomy and drainage of a perirenal abscess were performed fourteen years previously, and since this operation, the patient had had periodic attacks of pyelitis and cystitis until three years before admission to the hospital, when several abscessd teeth had been removed. She presented a history of

infection of the sinuses for many years, with extensive intranasal operations ten years previously. Constant headache, worse on the right during the past three years, had been present. She had had frequent colds, but no acute attacks of tonsillitis. A constant postnasal discharge had been present.

Examination.—The fundi looked normal. There was contraction of the visual field on the right, with multiple scotomas for form and color. The left eye was affected to a less extent. Figure 8 shows the increase in size of the red field in each eye after all ethmoidal infection had been removed and also the location of the scotoma.

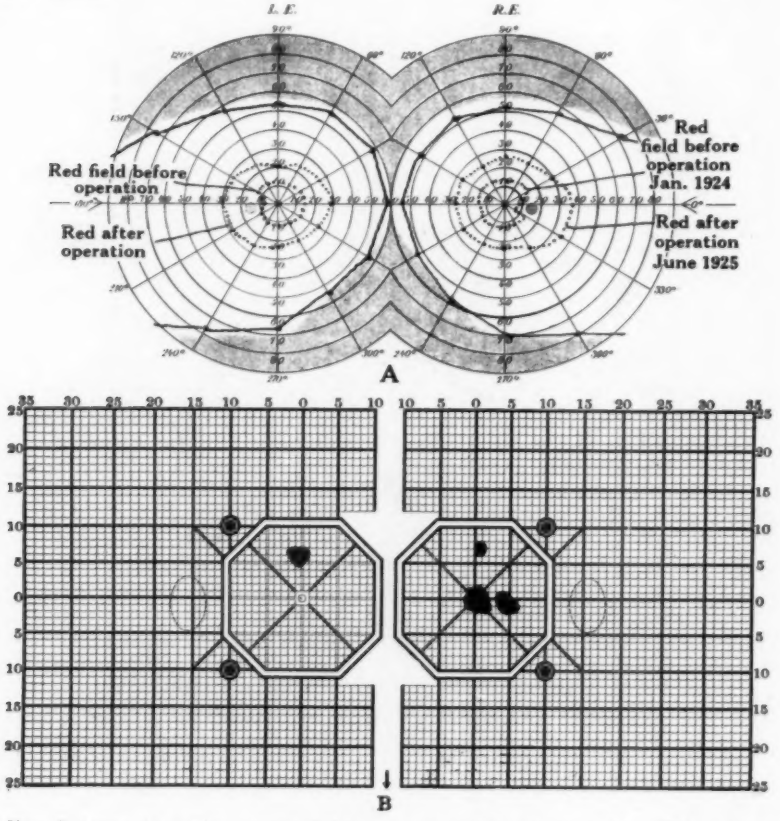

Fig. 8 (case 4).—The visual fields are normal for form (*A*). There was an increase in the red field in each eye after all the infected ethmoidal cells had been located and opened. In January, 1924, multiple scotomas were found in the stereocampimeter, affecting especially the points of fixation. They had entirely disappeared by June, 1925. *B* indicates the position of the scotomas.

The tonsils were small, adherent and fibrous, with marked hyperemia of the anterior pillars of the fauces. The glands at the angle of the jaws and in the posterior triangles were enlarged. The teeth were not infected. The antrums and the frontal sinuses were clear on transillumination and roentgenographically (fig. 7). The septum was deflected to the right. There was a purulent discharge on both sides coming from the region of the posterior ethmoidal and sphenoidal sinuses. Infected lymphoid tissue was present in the nasopharynx.

Results of all other examinations were negative.

Therapy.—In January, 1924, both sphenoidal sinuses were opened. Free pus and polypi were found in the right; a thickened mucous membrane was present in the left sphenoidal sinus. This relieved the headache to some extent but did not improve the blurring for near vision.

In January, 1925, a submucous resection of the nasal septum was performed, the posterior half of the middle turbinate on both sides was removed and all posterior ethmoidal cells on both sides were opened. The tonsils and adenoids were also removed. After this operation the headache disappeared, and there

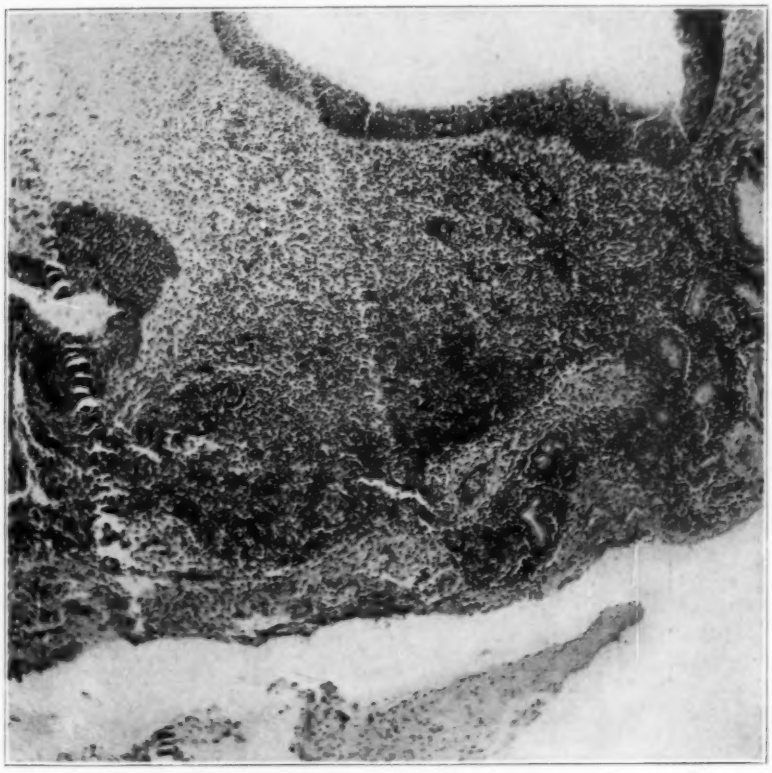

Fig. 9 (case 4).—Appearance of mucous membrane from a posterior ethmoidal cell that was located above the right sphenoidal sinus. This cell was overlooked at the first two operations, and it is noteworthy that the visual disturbance did not clear up until this cell was located and drained.

was some improvement in vision. Following an acute coryza six weeks later, the headache over the forehead and behind the eye on the right recurred, and vision again became worse in the right eye.

In April, 1925, it was found, on examination, that the infection had recurred in the right posterior ethmoidal region with the formation of small polypi. These cells were again cleaned out by intranasal operation. Figure 9 shows the infected mucous membrane removed at this operation.

Subsequent Course.—After the last operation, the general health greatly improved. The patient gained 20 pounds (9 Kg.) within six months. The headache entirely disappeared. The vision in both eyes had been normal for eighteen months. The scotoma disappeared within three months after the last operation. The operative field in the nose was clean in April, 1927. The polypi or discharge had not recurred.

Comment.—It seemed clear that the lesion in the right optic nerve in this patient was secondary to the infection in the upper air passages. It should be

Fig. 10 (case 5).—Clinically, the posterior ethmoidal cells on both sides were infected in this patient. A roentgenogram taken with the forehead on the plate shows the frontal sinuses and the anterior ethmoidal cells clear.

noted that the visual acuity did not return to normal and that the scotoma did not disappear until all the infected mucous membrane in the posterior ethmoidal sinuses had been removed.

CASE 5.—*History.*—A white woman, single, aged 39, was admitted to the hospital in December, 1925, complaining of impaired vision in the left eye for three months. The past history was unimportant, with the exception of frequent sore throat and a nasal discharge that was relieved by removal of both middle turbinates and the tonsils and adenoids twelve years previously. The onset of the visual disturbance in the left eye was sudden and was not associated with an acute coryza, headache or any noticeable discharge in the nose or throat. The vision had rapidly become worse during the past three months.

Examination.—The corrected vision on the right was 20/15 and on the left, 8/100. A large central scotoma, with an enlarged blind spot, was present in the left eye. The fundus on the left was slightly edematous around the disk. The teeth were not infected. The nose was not discharging. Both middle turbinates were absent. No polypi were found. The only evidence of infection of the sinuses was a localized hyperemia of the mucous membrane in the region of the posterior group of cells on both sides. The frontal, maxillary and sphenoidal sinuses were clear on transillumination and roentgenographically (figs. 10, 11 and 12).

Fig. 11 (case 5).—The same patient as in figure 10, with the tip of the chin on the plate, showing the frontal and maxillary sinuses clear.

Therapy.—Both sphenoidal sinuses were opened and found to be normal. Polypoid mucous membrane was found in the most superior and most lateral of the posterior ethmoidal cells on both sides (fig. 13). Free pus was not seen. Culture showed *Staphylococcus albus.*

Subsequent Course.—On the sixth day after operation, the corrected vision in the right eye was 20/15 and in the left eye, 20/20, corrected. The size of the central scotoma had markedly decreased. At a second examination seventeen days after operation, the vision in the bad eye (left) was 20/20; the retinal edema had disappeared; the blind spot was still enlarged, but the central scotoma had entirely cleared up. The vision in this patient had remained normal until April, 1927. The sinuses that were opened had healed, and polypi, discharge or other evidence of infection of the sinuses were not present.

Comment.—In this patient, there was almost complete blindness on the left that had been growing worse for three months. The general physical, neurologic and serologic examinations were negative. No focus of infection was found other than a thickened mucous membrane infiltrated with inflammatory cells in those posterior ethmoidal cells which were nearest the optic nerves. The explanation of the fact that the ethmoidal cells were infected on both sides and the optic nerve was involved only on the left is probably referable to the anatomic difference in the thickness of the bony wall that separates the sinus cavity from the orbit.

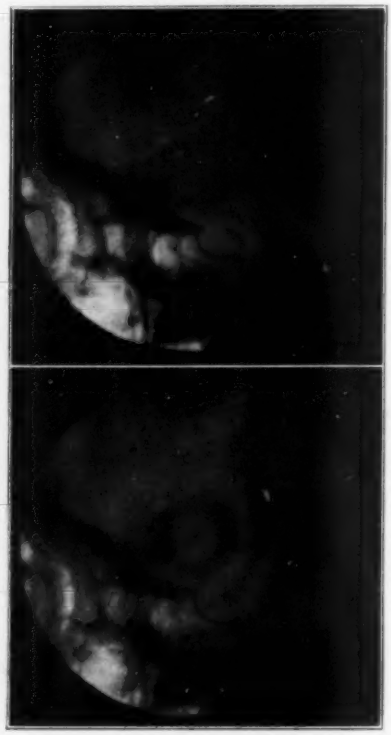

Fig. 12 (case 5).—The stereoscopic lateral view shows the sphenoidal sinuses clear. The roentgenologic diagnosis was: no infection of the accessory nasal sinuses. Clinical examination and operation disclosed an infection limited to one or two posterior ethmoidal cells on each side. After operation, the vision rapidly became normal.

Case 6.—*History.*—A white woman, aged 53, was admitted to the hospital in April, 1922, complaining of rapid loss of vision in both eyes. The only point of importance in the past history was that the patient had had a nasal discharge for many years, and three years before admission an intranasal operation for the removal of nasal polypi on the left. There was no history of headache. The onset of the visual disturbance was sudden and was not associated with a coryza or any other illness. A small round spot was noticed before the left eye three weeks before admission; this rapidly increased in size, and two

days later she had lost all sight and perception of light in the left eye. A week later she noticed a spot before the right eye, and the loss of vision in this eye was rapid.

Examination.—The examiner was unable to get a visual field in either eye. There was no color perception in either eye. The pupils were dilated. Nothing abnormal was seen in the fundus on either side.

Examination of visual acuity revealed that the left eye was blind, and that the patient could only count fingers at a distance of 6 inches (15.2 cm.) in the right eye.

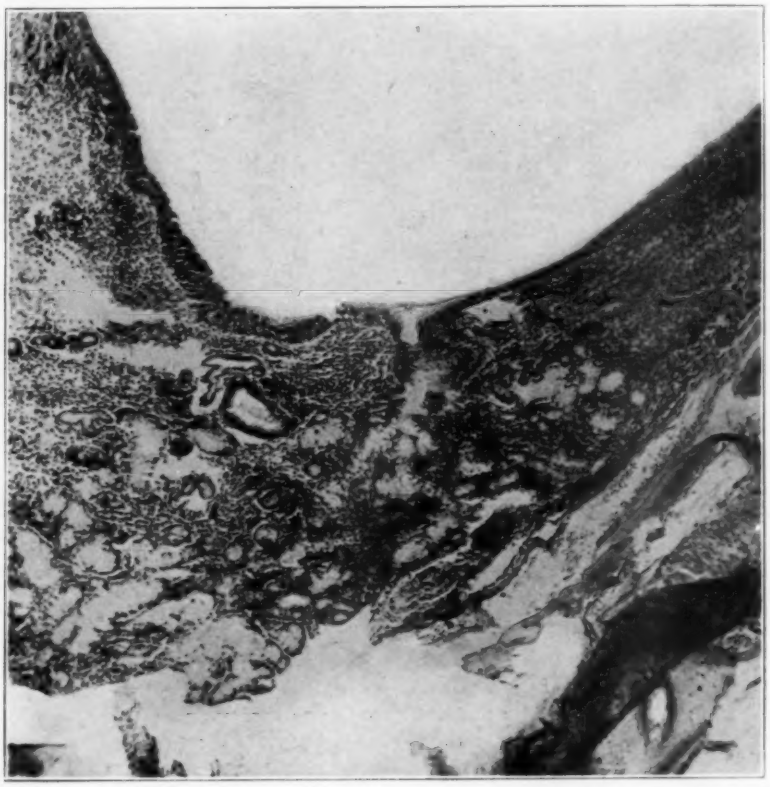

Fig. 13 (case 5).—Beginning dilatation of the mucous glands (myxomatous degeneration) and cellular infiltration of the mucous membrane of a posterior ethmoidal cell. This infection was the cause of the visual disturbance.

The teeth had all been removed. The tonsils were not infected. Both sides of the nose were filled with polypi—evidently a long standing pansinusitis.

Results of the neurologic, serologic and general physical examinations were negative.

Therapy.—The middle turbinates were removed, and all ethmoidal and sphenoidal sinuses were widely opened on both sides. Every sinus was filled with polypi. At a later operation, a radical operation was done on the antrums of each side. Figure 14 shows the appearance of the lining of an ethmoidal cell.

Subsequent Course.—There was no improvement in vision.

Comment.—The impairment of vision was first noticed about three weeks before operation on the sinuses, but the inflammatory process had in this short time damaged both optic nerves to such an extent that the restoration of vision was prevented by secondary atrophy. This patient's history illustrates the danger of delay when an impairment of vision is due to retrobulbar neuritis.

CASE 7.—*History.*—A white man, aged 49, was admitted to the hospital in June, 1925, complaining of dimness of vision. The only important point in the

Fig. 14 (case 6).—Appearance of mucous membrane of posterior ethmoidal sinuses. In this patient, the infection had so damaged the optic nerves that no improvement after operation was possible, due to secondary atrophy.

family or past history was that his sister and two of his children had died of tuberculosis. Impairment of vision was gradual and was first noticed eight months previously. He had never had headache, nausea or vomiting. He said that he had never had a chronic discharge in the nose or throat. He had lived in the southern part of Florida for many years.

Examination.—Visual acuity was 6/200 in each eye, and improvement was not possible by refraction. Extreme pallor was present in the temporal half of the optic disk. Some deep choroidal degeneration was noticed in the right eye.

There was little constriction for form in the visual fields, but a large central scotoma, absolute for red and relative for white was present (fig. 15).

Discharge or polypi were not seen in either side of the nose. There was good breathing space on both sides. With the nasopharyngoscope, a definite localized hyperemia of the mucous membrane was seen in the region of the orifice of the antrum and the posterior ethmoidal cells on each side. Both transillumination and the roentgenogram indicated a thickening of the membrane lining the left frontal sinus and both maxillary sinuses.

Results of the neurologic examination, roentgen-ray examination of the teeth, tuberculin tests and general physical examination were negative.

Therapy.—The posterior ends of the middle turbinates were removed under local anesthesia, and the posterior ethmoidal and the sphenoidal sinuses were opened. The sphenoidal sinuses were normal, but some of the ethmoidal cells contained polypoid mucous membrane (fig. 16).

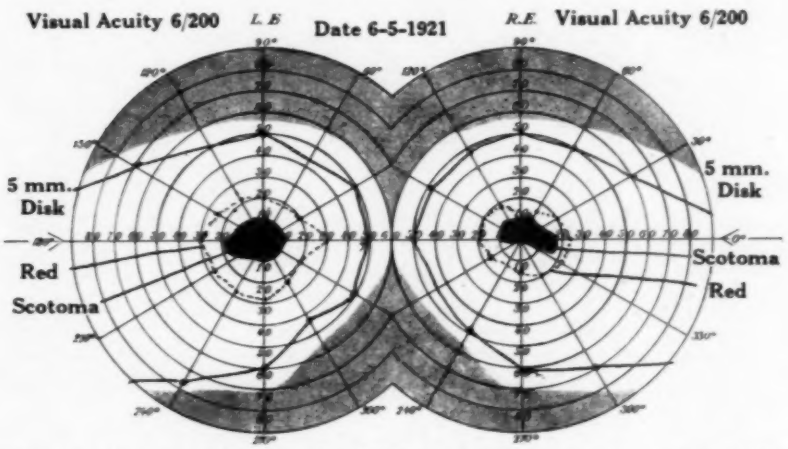

Fig. 15 (case 7).—Visual acuity 6/200 in each eye. A large central scotoma for color is present in each eye. Only slight improvement in vision followed operation on the infected sinuses.

Under ether anesthesia, both of the maxillary sinuses were opened through the usual incision under the upper lip, and the left frontal sinus through an external incision. A low grade inflammatory process with thickening of the mucous membrane was found in each of these sinuses. After a piece was removed for miscroscopic examination and culture, adequate drainage was established into the nose and the wounds were closed without removing the lining membrane of these sinuses.

Subsequent Course.—There was some improvement in the vision within a few days after the operation. On the sixth day after the first operation, the visual acuity was 20/200 on the right and 18/200 on the left. There was no further improvement when the patient was seen six months later. The scotoma was still present in each eye.

Comment.—This case is another example of a combined retrobulbar neuritis with atrophic changes in the papillomacular bundle and choroidal degeneration secondary to a low grade chronic sinusitis that had not given rise to any of the common symptoms of sinusitis. This patient did not have headache,

nasal obstruction, frequent colds or a chronic discharge. The papillomacular fibers had been so badly damaged during the eight months during which he had noticed a dimness of vision that complete restoration of vision was not possible. A hemolytic streptococcus was isolated from the posterior ethmoidal sinuses. The roentgenographic appearance of the frontal and maxillary sinuses is shown in figure 17.

CASE 8.—*History.*—A white woman, aged 45, was admitted to the hospital in June, 1921; she was completely blind in the left eye and could only count fingers with the right eye. The history and various examinations were all negative, with the exception of the accessory nasal sinuses. There was a history of a suppurative sinusitis with purulent discharge and obstruction to breathing,

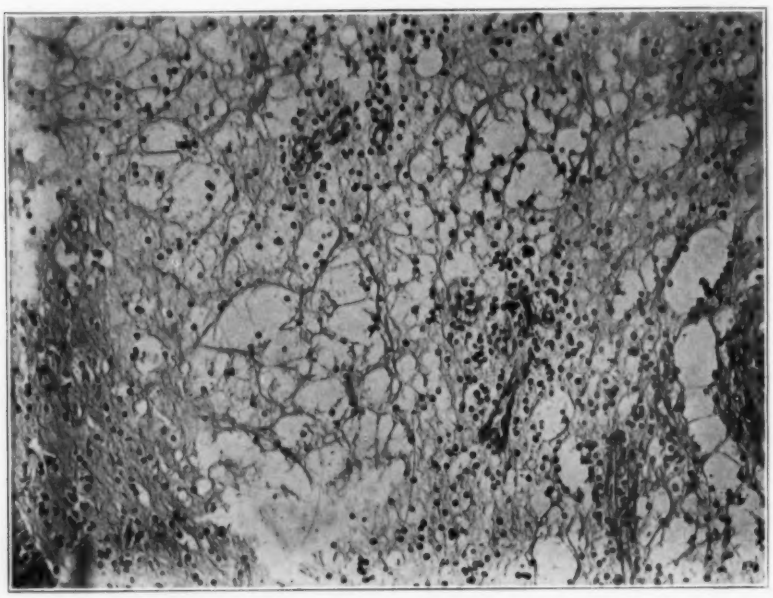

Fig. 16 (case 7).—The microscopic appearance of the mucous membrane from the posterior ethmoidal sinuses.

due to polypi, that dated from an attack of influenza six months previously. Five weeks prior to admission, she had had the last of a series of nasal operations for the removal of polypi.

Examination.—Marked secondary atrophy of the nerve head was present on both sides. The disk was clearly outlined on the left, but the margins were indistinct on the right. Visual acuity was not present on the left and on the right it was 2/200. There was marked contraction of the visual field on the right (fig. 18).

Pus was coming from the sphenoidal, ethmoidal and maxillary sinuses on both sides.

Therapy.—Due to the fact that this patient had had several nasal operations and that both middle turbinates and all the landmarks were gone, the ethmoidal and sphenoidal operation was done through an external incision. A nonhemolytic streptococcus in pure culture was recovered. The appearance of the

mucous membrane from the posterior ethmoidal cells was almost identical with that shown in figure 16. A radical operation on the antrums of both sides was done a few days later.

Subsequent Course.—The vision did not improve, and the patient was totally blind by the eleventh day after the last operation.

CASE 9.—*History.*—A white woman, aged 67, was admitted to the hospital in December, 1921, complaining of failing vision in the left eye. She was 50 pounds (22.7 Kg.) overweight, with hypertension, chronic nephritis, generalized arteriosclerosis and myocarditis. A constant nasal discharge and loss of the

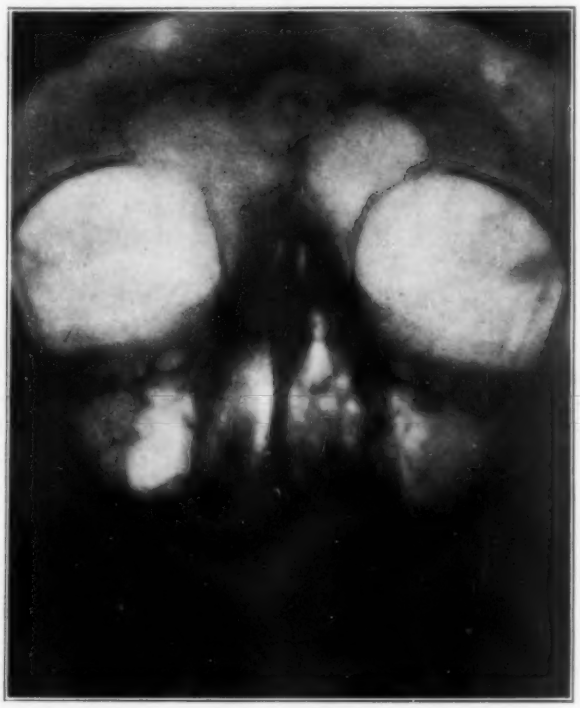

Fig. 17 (case 7).—Infection of one frontal and both maxillary sinuses. The roentgenologic diagnosis was confirmed at operation.

sense of smell had been present for twelve years. The dimness of vision was first noticed one week prior to admission.

Examination.—The outlines of the disks were blurred on both sides, but the elevation was not more than 1 diopter. The veins were full with a suggestion of deep hemorrhage along the lower temporal vein on the left. The arteries were sclerotic. Marked retinal degeneration was present in the macular region on the left. Visual acuity in the left eye was 2/200; in the right, 20/80. A large central scotoma was present on the left.

Examination.—All the teeth had been removed. Polypi and a purulent discharge were present above the posterior end of the middle turbinate on both sides. The maxillary sinuses were infected; the frontal sinuses were clear.

Therapy.—The infected sinuses were opened, and all the lining mucous membrane was removed. Dietary treatment was instituted in order to improve the general condition.

Subsequent Course.—Figure 19 shows the visual field on the day before the operation in December, 1921, and figure 20 the visual field four months later.

Five years later, the patient wrote that she was in good health and that the vision in the right eye was normal.

Comment.—The visual disturbance in this patient may have been due to a combination of the renal condition, arteriosclerosis and infection of the sinuses. In cases of this kind, however, a series of radical operations for the cure of the chronic suppuration in the sinuses is indicated for the renal condition, even in the absence of a large central scotoma or other evidences of a retrobulbar neuritis. The fact that this patient was in good health and had normal vision in one eye after five years is justification for radical operations that will cure

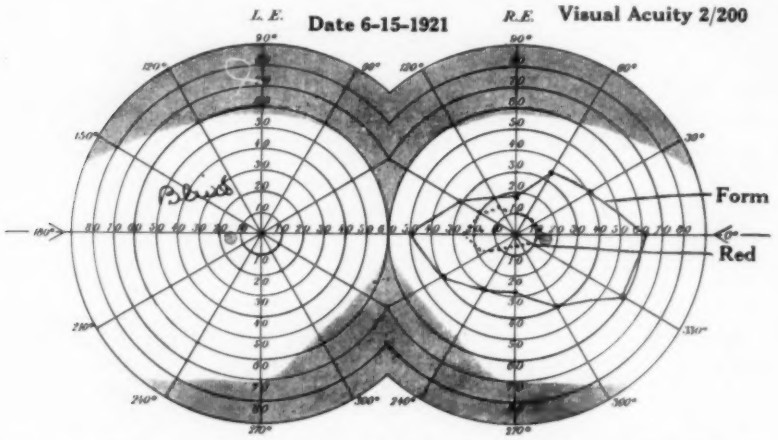

Fig. 18 (case 8).—Visual fields before operation. This patient was blind in both eyes on the eleventh day after operation of the sinuses—due to secondary atrophy.

the infection rather than simpler measures such as the repeated removal of polypi, irrigations, suction and vaccines.

Case 10.—*History.*—A white woman, aged 22, was admitted to the hospital in September, 1925, complaining of dimness of vision in the right eye for six days. The general health was excellent. The onset of the visual disturbance was sudden, and was not associated with a coryza or any other illness. She had never had headache or discharge in the nose or throat. A "film" suddenly appeared before the right eye, and the vision rapidly failed.

Examination.—The general physical, neurologic and serologic examinations were all negative. On September 28, before the operation was performed on the sinuses, the best corrected vision was 20/100 in the right eye and 20/20 in the left eye. There was a large paracentral absolute scotoma without apparent atrophy of the optic nerve on the right. The left eye was normal.

The tonsils had been removed eight years previously. The teeth were normal. Polypi or discharge were not present in the nose. There was no

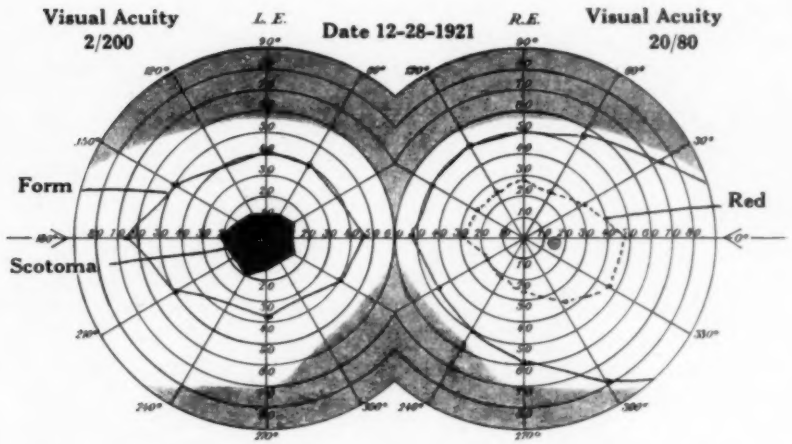

Fig. 19 (case 9).—Visual acuity 2/200; large central scotoma and marked optic atrophy on the left. Visual acuity 20/80 in the right eye; outlines of the disks are blurred on both sides—a low grade choked disk.

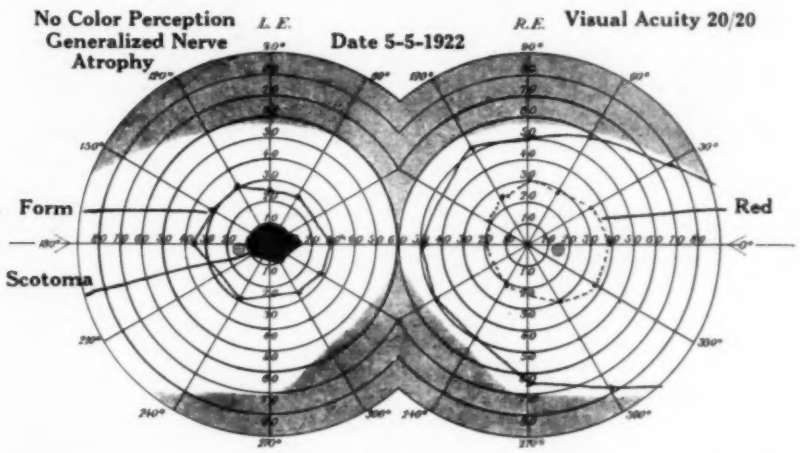

Fig. 20 (case 9).—Visual acuity 20/20 in the right eye, four months after operation. The patient wrote five years later that the right eye was normal. He was practically blind on the left.

evidence of chronic infection in the nasopharynx. With the nasopharyngoscope, a localized hyperemia of the mucous membrane around the posterior group of sinuses was seen. Headache was not present. The roentgen ray and transillumination revealed a normal condition on both sides.

Therapy.—Under local anesthesia, the posterior half of each middle turbinate was removed and the posterior ethmoidal and sphenoidal sinuses opened widely. The sphenoidal sinuses were normal, but thickened mucous membrane was found in some of the ethmoidal cells on each side (fig. 21). Hemolytic *Staphylococcus aureus* was grown in pure culture from the ethmoidal mucous membrane.

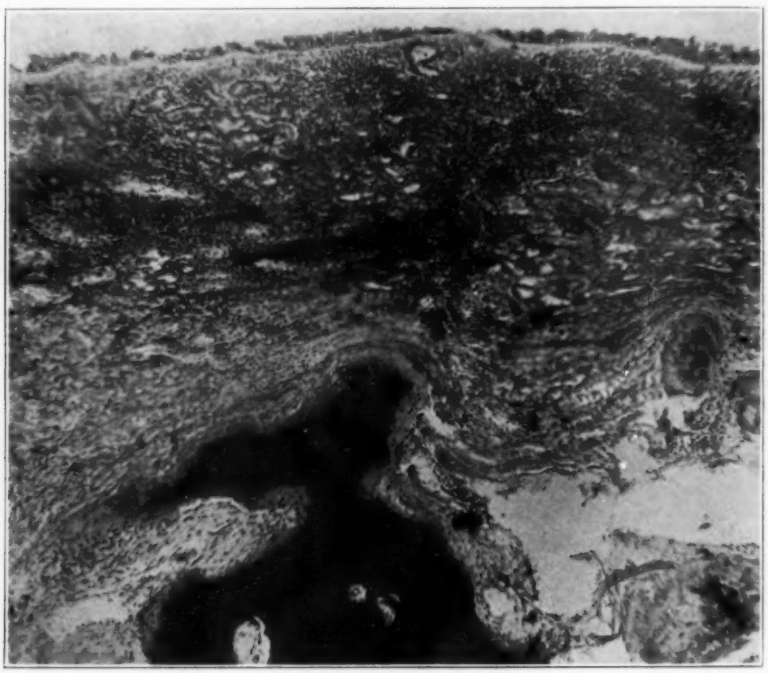

Fig. 21 (case 10).—Appearance of mucous membrane removed at operation from posterior ethmoidal sinuses. No other sinuses were infected. This patient gave no history of coryza, discharge or headache. Roentgen-ray examination of the sinuses was negative. The nature of the lesion, the absence of any of the common causes of retrobulbar neuritis on general examination, and a definite localized hyperemia of the posterior end of the middle turbinates were the indications for the exploration of the sinuses in this patient.

Subsequent Course.—Subjectively, the "film" over the right eye began to clear within a few hours after the ethmoidal sinuses were opened. On October 17, about three weeks after the operation, the visual acuity in the right eye was 20/30 and in the left, 20/20. The absolute scotoma in the right eye had entirely disappeared, but a faint relative scotoma for red remained. Three months later the vision was subjectively and objectively normal—20/20 in the left eye and 20/20 in the right. There was still a faint suggestion of the

scotoma for red in the right eye. A year and a half after the operation, the vision was normal and the sinuses that were opened were lined with a smooth epithelium.

Comment.—This is a classic case of retrobulbar neuritis. The posterior ethmoidal sinuses on both sides were infected with a hemolytic staphylococcus, but there was nothing in the history, the roentgenograms of the sinuses or the nasal examination to suggest an infection of the sinuses, with the exception of the localized hyperemia around the posterior group of sinuses. In the absence of any other evident etiologic factor, the rapid loss of vision with a normal looking fundus and a central scotoma justifies an operation on the ethmoidal and sphenoidal sinuses.

It was pointed out that an infection in the sphenoidal or posterior ethmoidal sinuses on one side may damage the optic nerve on the opposite side; therefore, it is often wise to open the sinuses on both sides. Other cases in this report illustrate the dangers of delay in eliminating the focus of infection until the optic nerve has been irreparably damaged and undergoes secondary atrophy.

INFANTILE MASTOIDITIS WITH GASTRO-INTESTINAL SYMPTOMS*

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ST. LOUIS

In view of the fact that routine autopsies at the St. Louis Children's Hospital on infants who had died of so-called cholera infantum due not to food poisoning but to some parenteral infection had not disclosed any evidence of the focus responsible for the disease, more thorough examinations were made. In the fall of 1923, pus was found in the mastoid antrums of infants who had died of gastro-intestinal disturbances, and who did not show any other focus of infection.

At that time we were not familiar with the work of Maurice Renaud of Paris, nor with that of Dean and Byfield of Iowa City.

In 1921 Renaud[1] reported that he had performed autopsies on seventy infants who had died of infantile diarrhea, and had found pus in the mastoid antrums in every case. In thirty cases the ear infection had been noted before death, but in the other forty, it had been overlooked. Following this he operated on the mastoid antrums of ten such infants. Temporary improvement was noticed in all of them, but nine eventually succumbed and only one survived. He attributed this high mortality to the fact that the infants were practically moribund when the antrums were opened, and felt that if the operations had been performed earlier the death rate would have been lower.

After the postmortem discovery of pus in the mastoid antrums of these patients, an intimate relationship developed between the departments of pediatrics and otolaryngology, and a more intensive study of the ear, nose and throat was made in such cases.

We began to operate on some of the patients, and, in 1925, Dr. A. M. Alden and I presented a paper before the American Laryngological, Rhinological and Otological Society reporting mastoid operations on fifteen infants under 2 years of age, in whom the predominating symptoms were gastro-intestinal, with eight recoveries and seven deaths.

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* Read before the American Laryngological, Rhinological and Otological Society, at Atlantic City, May 26, 1927.

* This paper presents the combined work and opinions of the Departments of Otolaryngology and Pediatrics of the Washington University School of Medicine.

1. Renaud: Bull. et mém. Soc. méd. d. hôp. de Par. **45**:1326, 1352 and 1384, 1921.

Since that time the study of this type of mastoiditis has been carried on as cases were available, in cooperation with the department of pediatrics, under the direction of Dr. W. McKim Marriott; and our opinion that this type of case presented a problem of great importance which could be solved only by the combined efforts of the pediatrician and the otologist has been confirmed by further experience. Our observations, together with the reports of other investigators in various parts of the country, convince us more firmly than ever that a focus of infection in the ear may be responsible for diarrhea, vomiting and loss of weight in infants, and that the treatment in such cases requires prompt otologic surgery.

The history in these cases consists of failure to gain normally in weight, with more or less serious gastro-intestinal symptoms from time to time, and, in the severe types, marked loss of weight, vomiting, diarrhea, anhydremia, extreme toxicity and a septic temperature which often goes as high as 104 or 105 F. These symptoms do not yield to any regulation of feeding, nor are they due to enteric infection. Other possible causes are eliminated by a careful and thorough pediatric examination.

The impression prevails in some quarters that observations on the ear in these cases are either wanting or of minor importance, and that the diagnosis and question of operation must be decided by the pediatrician. Such is not the case. The ears in these cases nearly always present characteristic features which the otologist should recognize; and the question of operation should be decided, as in all mastoid cases, by a consideration of the otologic picture, the general condition of the patient and the progress of the case.

If the infant is strong and in good condition, and the severity of the symptoms diminishes after incision of the drumhead, the mastoid operation may be deferred; but if the gastro-intestinal symptoms do not subside after drainage through the tympanic membrane, or, if the general condition of the infant is poor, the mastoid antrums should be opened promptly, and the poorer the condition of the patient, the more imperative is prompt surgical intervention. Opening of the mastoid antrums in these infants is not a radical procedure, but it is simply the carrying out of the sound, surgical principle of thoroughly draining a focus of infection. When this operation is carefully performed, under local anesthesia, it is not dangerous; and we believe that none of the deaths in the cases reported by us were due to, or hastened by, the operative intervention, and that if the antrums had been opened earlier in some of the cases, there would have been fewer fatalities. We also feel that prompt operation in these cases of infection of the middle ear aids in conserving the hearing by hastening the healing process in the tympanic cavity.

A short review of the anatomy of the infantile temporal bone will aid in explaining the otologic features of these cases:

The inner end of the membranous canal is attached directly to the annulus tympanicus, as at this age there is no bony canal. The squamous portion of the temporal bone does not yet project horizontally outward, as in the adult, and the annulus tympanicus is almost in the same plane as the superior wall of the membranous canal; consequently, the superior and inferior walls lie in apposition to each other, making it necessary to

Fig. 1.—Otoscopic view of normal infantile drumhead, showing continuity of the posterior superior quadrant with the membranous canal wall.

Fig. 2.—Otoscopic view of normal adult drumhead, showing posterior superior quadrant in same plane as the rest of the drumhead.

pull the auricle downward and backward in order to obtain a view of the drumhead. Only the anterior portion of the drumhead presents through the otoscope or speculum, that portion of the drumhead lying posterior to the malleus being practically in the same plane as the superior canal wall. Consequently, any bulge in the posterior portion of the drumhead will be downward instead of outward, as in the adult, and will simulate a sag of the canal wall, as seen in cases of mastoiditis in older patients. Because that portion of the temporal bone adjacent to the antrum does not yet form a part of the bony canal wall, as in the adult, a true sag of

the canal wall is rare, though occasionally seen in older infants; but the significance of the persistent bulging of the posterior superior quadrant, in spite of repeated incisions, is identical with that well known sign of mastoiditis in adults.

The drumheads in these cases are usually red and bulging. If the infection is in the lower part of the tympanum, the bulge may be in the anterior portion of the drumhead, and be outward, as in the adult; but

Fig. 3 Infantile drumhead. Posterior superior quadrant bulging downward.

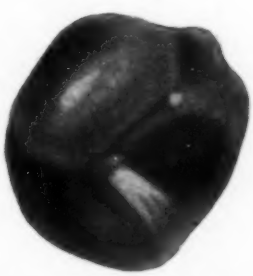

Fig. 4.—Adult drumhead. Posterior superior quadrant bulging outward.

if the infection invades the solid embryonal tissue above, the bulge will be in the posterior superior quadrant, will be downward and will simulate a sag of the canal wall. Incision through this portion of the drumhead reveals a thickened membrane, or even solid tissue. Usually, pus escapes, but the embryonal tissue within quickly obstructs drainage, and the next examination may show the same picture as before.

If the infant is extremely anhydremic, the drumhead may not be red, but a dull, dirty gray, and the bulge may be difficult to determine. We

believe that this peculiar appearance of the drumhead is but a part of the general anhydremic picture, and that incision of the drumhead will usually reveal pus. In case of doubt, this procedure, even though nothing is found, is much less harmful than failure to evacuate the pus which may be behind it.

The tympanic cavity, attic and antrum in the infant are filled with embryonal tissue, resembling granulation tissue in structure. Absorption of this tissue begins at birth but is not completed until the end of the first or second year. We believe that this accounts for the fact that many of the patients recover after repeated opening of the drumhead. As long as the infection is limited to the cavity already formed in the lower part of the tympanum by absorption of the embryonal tissue, incision of the drumhead will afford adequate drainage and the patient will go on to recovery; but, if the infection invades the solid embryonal tissue remaining in the upper portion of the tympanic cavity and antrum, adequate drainage through the drumhead is impossible, and opening of the mastoid antrum and removal of the infected tissue are necessary.

The simple operative technic used at present is as follows:

1. If there is no contraindication, a suitable dose of codeine or morphine is given one-half hour before operation.

2. The scalp is shaved behind and above the ear in the usual manner.

3. The field of operation is painted with 5 per cent trinitrophenol in alcohol.

4. The skin along the line of incision is infiltrated with 0.5 per cent procaine hydrochloride containing 10 drops of epinephrine hydrochloride to the ounce, and a deep injection is made beneath the periosteum in the region of the antrum.

5. The incision is made as close to the auricle as possible, extending upward from a point opposite the middle of the external auditory meatus (never lower than this because of the danger of injuring the facial nerve). The length of the incision varies from ¾ to 1 inch (1.9 to 2.5 cm.).

6. After the bleeding is controlled, the wound is inspected to see whether the periosteum has been incised. If not, this is now done.

7. The periosteum is carefully elevated from the incision forward and downward until the bony auditory meatus is well exposed. The periosteum posterior to the incision is not disturbed. The instrument used for this purpose is a small elevator, such as Freer's chisel-shaped septal elevator. The anterior lip of the wound is retracted downward and forward by means of a Cushing's vein retractor slipped beneath the elevated periosteum. This gives a good exposure of the posterior superior portion of the bony canal and the triangular area overlying the mastoid antrum.

8. The bony cortex over the antrum is now carefully removed with a 5 or 7 mm. hand gouge, to avoid the concussion of malleting.

9. After the antrum has been uncapped with this gouge, a culture is taken.

10. A small curet is used gently to clean out the contents of the antrum and to remove the overhanging bone.

11. A probe is inserted through the aditus ad antrum to be certain that the object of the operation has been accomplished.

12. A rubber or gauze drain is inserted into the antrum, the hemostats and retractor are removed and a dry dressing is applied.

13. Usually, sutures are not required, but, if desired, the upper part of the wound can be brought together with through-and-through silk worm gut sutures.

14. In these cases dressings are made daily, especial care being exercised to keep the antrum open until all discharge from the ear canal has ceased.

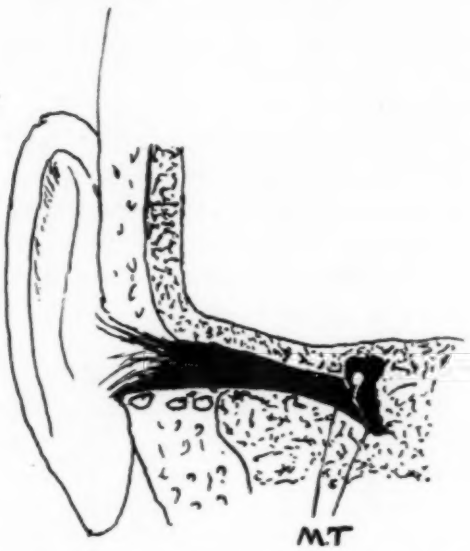

Fig. 5.—Section of adult temporal bone, showing the angle between the drumhead and the superior canal wall. *M. T.* indicates tympanic membrane.

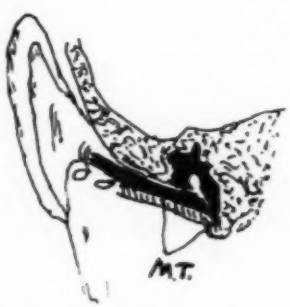

Fig. 6.—Section of infantle temporal bone, showing continuity of the drumhead and the superior canal wall. *M. T.* indicates tympanic membrane.

Between Oct. 23, 1926, and April 20, 1927, mastoid operations were performed on forty-three infants under 2 years of age, in the St. Louis Children's Hospital. Of these cases, thirty presented marked gastrointestinal symptoms, with eight deaths; and thirteen did not present any

gastro-intestinal symptoms, with one death. This fatality was due to causes entirely extraneous to the ear infection.[2]

These figures show forcibly that in infants mastoid infections with gastro-intestinal symptoms are much more serious than those without, and that prompt and thorough operation is much more important in these cases than in the usual mastoid abscess.

Most careful examinations have been made in these cases, and all other possible sources of infection were excluded. They represent only those patients who failed to improve under proper diet regulation, transfusions, intraperitoneal injection of physiologic sodium chloride solution or Ringer's solution, intravenous injections of dextrose, etc., combined with incision of the drumhead and the usual treatment of otitis media; in many cases of the milder type recovery took place without surgical intervention.

The time of healing in these cases varies greatly: in some healing is complete in from ten days to two weeks, and in others there is no visible attempt at repair for a longer period than this after the operation. In one patient it was ninety-three days before the wounds healed, and another was in the hospital one hundred and twenty days. Frequently this delay in healing is due to coexisting infection in the upper respiratory tract. This phase of the problem cannot be considered in this paper, but, unless any nose and throat infection present is eradicated, mastoid healing will be delayed, and the infant will be subject to a recurrence of the ear condition.

Dressings should be made daily in these cases and care exercised to keep the mastoid wound open until all discharge through the ear canal has ceased; otherwise it may be necessary to reopen the antrums. Locally, the use of mercurochrome-220 soluble has proved helpful.

Needless to say, careful attention to the diet and general condition of the infant is of the greatest importance.

Nearly all of the patients had bilateral infections with the opening of both mastoid antrums. In almost every one of the few cases in which operation was performed only on one side, it was necessary to

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2. This infant, aged 6 months, was admitted Dec. 11, 1926, with a swelling involving the front and both sides of the neck, extending upward into the floor of the mouth, and on both sides of the face. It proved to be an hygroma, with secondary hemolytic streptococcus infection. The growth had first been noticed at the age of 2 weeks, but it had enlarged rapidly shortly before admission. Because of the extent of the growth and the condition of the patient, it was thought that operation should not be performed. Double otitis media developed on December 21. The antrums were opened on December 28 and found to be infected. The infant died January 19 of general septicemia (hemolytic streptococcus).

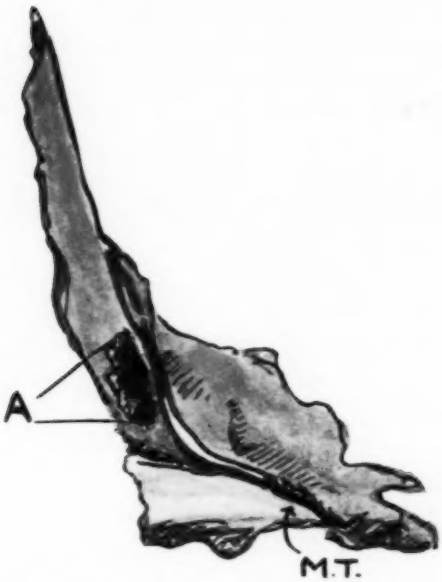

Fig. 7.—Sketch of infantile temporal bone, showing thick layer of bone between the antrum and the canal wall (usual type). *A* indicates antrum and *M. T.*, tympanic membrane. Mastoiditis in this type of bone would not cause a "sag" of the superior canal wall.

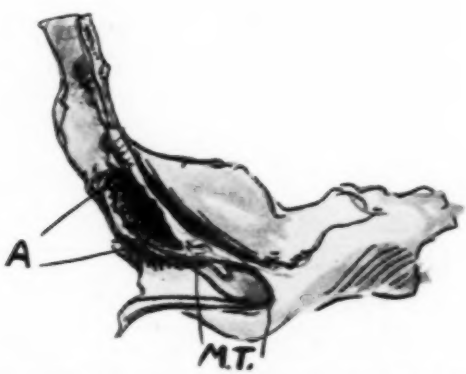

Fig. 8.—Sketch of infantile temporal bone, showing thin layer of bone between the antrum and the canal wall. *A* indicates antrum, *M. T.*, tympanic membrane. Mastoiditis in this type of bone might cause a true "sag" of the canal wall as in adults.

open the opposite antrum later. These antrums contained frank pus, or a thick, ropy, mucoid fluid. The embryonal tissue showed varying degrees of destruction. In one case, in an infant, 3 weeks old, the antral contents had been completely destroyed, and the bony wall of the antrum was black and rough.

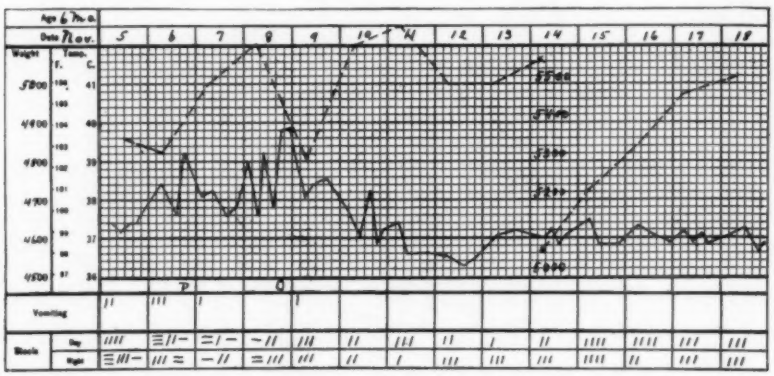

Chart 9.—Typical case of infantile mastoiditis with gastro-intestinal symptoms. The broken line indicates the weight in kilograms; the solid line, temperature; *P*, paracentesis; *O*, operation on the mastoid; short horizontal lines, watery stools, and oblique lines, normal stools. No diarrhea or vomiting occurred after date of operation, November 8.

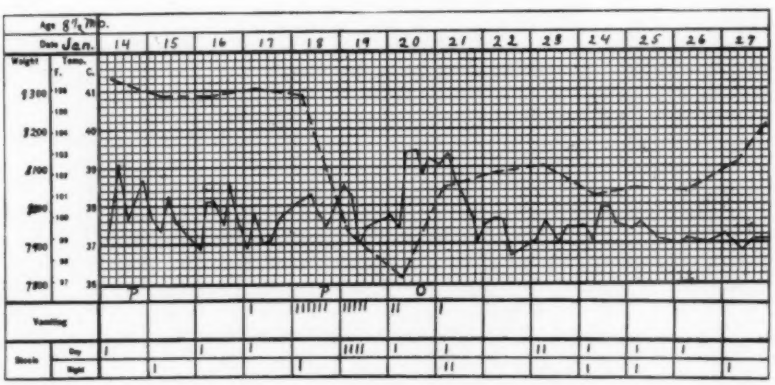

Chart 10.—Chart showing loss of weight and vomiting beginning January 18. The operation was performed January 20. The broken line indicates the weight in kilograms; the solid line, temperature; *P*, paracentesis, and *O*, mastoid operation.

Dr. Bernard J. McMahon, who has been making a study of the pathologic tissue removed, states that marked changes in the bone have not been observed. This probably explains the fact that we have not received any material assistance from roentgen-ray studies of the mastoids.

Dr. Alexis Hartmann has been investigating the blood chemistry in these cases, and he finds, among other things, that the chemical changes in the blood, in these cases of septic vomiting, are different from those occurring in vomiting due to other causes, such as pyloric stenosis.

When ten of twelve cultures in the first series of cases reported by Dr. Alden and me showed hemolytic streptococcus colonies, it seemed that there must be some definite relationship between the hemolytic streptococcus, or, more probably, some particular strain of that organism, and the gastro-intestinal symptoms observed in these cases. This belief was strengthened by the fact that these cases occurred in a miniature epidemic, and that then only sporadic cases were seen until last fall. Careful bacteriologic studies were made on the present series by Dr. Mary Spahr, in which cultures were obtained from sixty-seven mastoids. These showed seventeen different organisms, as follows: *Streptococcus hemolyticus, 27*; *Staphylococcus aureus,* 10; pneumococcus, type IV, 9; *Staphylococcus hemolyticus, 7*; diphtheroids, 6; *Streptococcus non-hemolyticus,* 4; pneumococcus, type III, 3; *Bacillus pyocyaneus, 2*; *Bacillus hemolyticus,* Morgan, 2; pneumococcus, type I, 2; *Staphylococcus albus,* 1; *Bacillus coli-hemolyticus,* 1; *Bacillus coli-nonhemolyticus,* 1; *Micrococcus catarrhalis,* 1; pneumococcus, type II, 1; a gram-negative baccilus, 1; a gram-positive bacillus, 1.

These different organisms did not show any special relationship to the gastro-intestinal symptoms, all of the more common varieties occurring in cases both with and without gastro-intestinal disturbances. So, while it may be possible that the *Streptococcus hemolyticus,* or some special strain of that organism, is a special etiologic factor in the production of gastro-intestinal symptoms in these cases, it is certain that many other organisms can produce the same effect.

Another striking and unexpected fact was that none of the nine infants whose mastoids gave pneumococcus cultures had pneumonia.

Operations were performed by the following members of the department of otolaryngology: Drs. A. M. Alden, M. F. Arbuckle, J. B. Costen, L. E. Freimuth, W. B. Hoover, B. J. McMahon, A. W. Proetz and H. W. Lyman.

The closest possible cooperation should exist between the pediatrician and the otologist, in cases of gastro-intestinal disturbances in infants, and if otitic infection exists, the prompt and thorough elimination of this focus will greatly lower the death rate.

Those who are as yet unconvinced of this fact are urged to open the antrums in some cases, under local anesthesia, or, if this is not done, to examine them post mortem.

700 Carleton Building.

DISCUSSION

DR. BERNARD J. MCMAHON: In discussing the microscopic pathologic observations that I have encountered in the tissue removed from the mastoids of infants, it would be premature to draw any definite conclusions. All the tissue removed is preserved in a solution of formaldehyde, decalcified, stained with hematoxylin and eosin and examined thoroughly. I shall mention but a few of the salient changes encountered in more than 100 sections of the material removed at operation from forty-three patients.

The bone varied from the normal cartilaginous to fully established young bone. It was necrotic in the central portions or reabsorbed along the peripheral margins or sclerotic. Other areas showed infiltrations with polymorphonuclear leukocytes and all the forms of connective tissue cells. The osteoclasts and pure osteoblasts were conspicuous by their absence. The interspaces were filled either with normal areolar tissue containing the lamellar, plasma and older connective tissue cells, in normal or greatly increased numbers, or with polymorphonuclear leukocytes.

The periosteum showed a fibrous thickening of various degrees in certain places, while in others in the same specimen it was unchanged; yet in some places there was a marked infiltration with red blood cells or polymorphonuclear leukocytes.

In practically all the slides examined, the mucosa showed more or less edema and infiltration with polymorphonuclear leukocytes and connective tissue cells in various stages of development. In a certain number of cases, much free blood was also present. I am looking forward to finishing this work in the near future, and I hope to be able to establish some significant relationship between the symptoms, both local and constitutional, and the gross and microscopic pathologic processes, so that in making the prognosis the physician may be guided by the actual pathologic process.

I should like to present a case that I consider one of the most typical and illustrative of my entire series. J. W., aged 4 weeks, was referred to me by Dr. Maurice Lonsway, a pediatrician, on account of persistent vomiting, diarrhea, loss of weight, dehydration and temperature since he was 10 days of age. I may mention here that the first child of Mrs. W. had died at the age of 6 weeks from a similar malady three years previously, before this work had been started in St. Louis. The infant, J. W., had been a patient in the St. Louis Children's Hospital since it was 2 weeks old, all symptoms persisting in spite of a rigid dietetic regimen. About a week before I saw him, the ears had been incised by the pediatrician, but since a discharge had not been obtained, they were considered normal. On my first examination both drums were lusterless, slightly reddened and slightly flattened in the posterior superior quadrants, especially the left. There was no sag of the wall of the canal. The nasal mucosa was more moist than it should be; otherwise it was normal. The pharynx and tonsillar areas were moderately reddened, but not significantly so, considering the frequency of the vomiting. The patient's weight was about 4½ pounds (2 Kg.). A bilateral paracentesis was performed; both drums gaped, and the mucosa of the middle ear was seen to be grayish, slightly thickened and very moist, but there was no frank discharge. A small applicator inserted into the middle ear brought out a small string of mucus. This was cultured, as was the moist tip of the paracentesis knife—both cultures from both sides grew a fine *Staphylococcus albus*. Within twenty-four hours, the temperature had dropped from 103 to 99 F. The drums were kept open, and daily applications of 1 per cent mercurochrome-220 soluble were made to the middle ear. The slight mucoid discharge continued.

The vomiting began to lessen; the diarrhea was checked. The weight began to go up at the rate of from 30 to 100 Gm. a day. At the end of ten days, the patient's condition was progressing so favorably that I permitted one drum to close. Within eight hours, the patient began to vomit a little, and he had a little diarrhea; the temperature rose to about 102 F. The drum was immediately incised, and within twenty-four hours the symptoms disappeared. After ten days, this performance was repeated, and the drum was reopened. After ten days more, all symptoms had completely disappeared; the weight had increased by about 800 Gm. above that at my original examination; I permitted both ears to close. Within twenty-four hours, the symptoms returned with renewed intensity. There was an immediate loss of more than 100 Gm., and the drums were slightly prominent. This time Dr. Lyman saw the patient with me and advised a bilateral antrotomy if closure of the drums again brought on the symptom-complex. This was done twenty-four days later, and a small amount of mucopus and granulation tissue was removed from both antrums.

The results of the microscopic examination were as follows: The bone on the left side showed occasional small areas of early rarefaction. The periosteum was slightly thickened. There was marked edema of the mucosa in some places and lymphocytic infiltration, also marked connective tissue cell infiltration of all ages, older forms predominating. The appearance of the bone on the right side was similar to that on the left. The periosteum was normal. The mucosa was similar to that on the left side with less marked fibrosis and lymphocytic infiltration.

Recovery was uneventful, and all symptoms subsided. The patient left the hospital in one week. The mastoids healed in ten days. There has not been any recurrence; at the time of this report the baby is 10 months old and above normal in weight. The hearing is apparently unimpaired.

Dr. L. W. Dean, Iowa City: In one of my cases a child, aged 6 weeks, was treated by myringotomy when mastoidectomy should have been performed. This was the pediatric treatment. In our clinic, Dr. Jeans stands on one side of the table and I am on the other side. We both look over the infant thoroughly. We want to find out everything we can. We make a complete examination. If we find pus in the ear, we often find later that the pediatric diagnosis, which at first seemed to be the most important, has taken the second place. One child was sent to me because the pediatrician found it was becoming progressively worse. Myringotomy was performed first, but in two days the infant was on the autopsy table. We found we were not getting anywhere by this procedure. We also found that if the child was very toxic, we had to perform mastoidectomy immediately. Sometimes we do not find the trouble in the ear. We find a nasal infection, pharyngitis, or acute tonsillitis. In two cases in which results of the examination of the ear were negative we found retropharyngeal abscess. There were two cases of abscess in the larynx. We have to look over the whole territory. I believe that if the infant is ill, whether it is 1 day old, or 4 years old, if pus is found in the pharynx, larynx or nasal sinuses, the child must be treated. Some infants do well after a myringotomy. In one case of cholera infantum the treatment was wholly nasal. After a few days, the child did very well. I think it is a matter of finding the infection and taking care of it. Before we instituted this practice we had not treated the patient for infection of the sinus, and then had the unfortunate experience of having autopsy performed on the infant before the whole staff of the hospital and finding pus in the sinus. In a case of acute otitis media, we did not do anything and the child recovered. Any gastro-intestinal symptoms in infants should arouse suspicions, even more

so than in adults. Sometimes these are due to wrong feeding; sometimes they are due to otitis; in either case, they appear similar. In one case a baby was found dead in bed. It was in a satisfactory condition and then the nurse noticed that it looked pale; the next time she looked at it, it was dead. Autopsy showed bilateral mastoiditis. In another case an infant had pneumonia and developed acute otitis. We performed a myringotomy, and the infant seemed to be doing satisfactorily. The next morning at 9 the child had a syncopal attack. We applied restoratives and the baby recovered. In the afternoon, death seemed imminent, but that child was saved by mastoidectomy. Dr. Jeans was not willing to state that the cause of death in these cases was mastoiditis, but that was the only condition we were able to find.

Dr. H. C. Ballinger, Chicago: I wish to report one case which came to autopsy in our service because the pediatrician could not find any condition and referred the case to us. Paracentesis had been performed in both ears, and discharge had not occurred. Next day a double operation on the mastoid was performed, and no pathologic condition was found, but at autopsy the mastoids were found to be full of purulent secretion and both were eroded.

Dr. J. A. Stucky, Lexington, Ky.: We have noticed in the public health clinic that in the younger children from the outlying districts, the oftener the meal is vomited the more frequently we find an atypical mastoiditis. Two years ago, we began prenatal care, and in the last year or two we have found that our cases of mastoiditis have diminished considerably. Two of my assistants said that it was not necessary to incise the mastoids in any of the young infants in our clinic. To my mind this illustrates that the sooner that otolaryngologists take an interest in the rational nutritional problem in children, the more good we shall be able to do. The syndrome of cholera infantum should always make us suspect infection of the ear. I was glad to hear members of this association emphasize the necessity of a more thorough examination and a further investigation than the pediatrician's suggestions. We should look beyond the ear. We make myringotomy an almost routine procedure. In our cases of mastoiditis in children we always use the modified blood clot dressing and a mastoid screen instead of a large bundle of bandages. We use a very small tube in the lower part of the wound. The ear is dressed daily and can be watched. The cavity of the middle ear is in sight and gets proper ventilation.

Dr. S. McCuen Smith, Philadelphia: This paper and the discussion by Dr. Dean bear out the importance of a routine examination in practically all general disease, especially in infants. Many times it has been pointed out in the pediatric department of the Jefferson Hospital that a patient has been admitted with pyelitis, pericarditis or pneumonia, and if we have an observant internist who has learned a great deal from the lectures he has heard, examination of the ear will reveal pus, and a prompt myringotomy will often relieve the child of other symptoms. I am at a loss to know, or rather to appreciate, the statement made by Dr. Lyman that he operates at the suggestion of the pediatrician. When symptoms of aural disease do not exist, I should be doubtful about operating, because if aural disease exists, there are usually symptoms; yet in an extreme case I have no doubt that operation is a practical procedure, because it has been proved to be so in these cases. One or two men in Philadelphia have been looked on as radical in regard to operations on the mastoid, but today they are not considered so, because it is being found that these operations are not only desirable, but even necessary. At the meeting of the American Otological Society the same subject was presented, and in following out Dr. Dean's observations one man said he had operated on a series of patients for the relief of cholera infantum

and that he did not find anything wrong with the mastoid in the cases in which operation was performed. Dr. Dean said that he would not operate unless he had some evidence. There is one important point to remember, and that is the position of the facial nerve in the infant. If the incision is lower than the lower border of the external auditory canal, there is danger of injuring the nerve and developing Bell's palsy, because the tip of the mastoid is not yet developed. I should like to ask about the objection to the use of general anesthesia in these cases instead of local anesthesia. I have never used local anesthesia. It takes so little general anesthesia in an infant that even if the patient is in extremis I have not seen any unfavorable results. Another point I should like to emphasize is that Dr. Lyman used the word, "paracentesis." Paracentesis literally means puncture, and, for the sake of efficient opening of the drumhead, it would be better to drop the word "paracentesis" and use instead the term, "incision of the drumhead," or better, "myringotomy." I have found that the younger physicians often only perform a puncture, which does not permit efficient drainage. I wish to repeat a question that I asked Dr. Dean at the New York meeting, and I did not hear his answer. He spoke of conservative nasal treatment. What is conservative nasal treatment? Dr. Dean mentioned this in connection with infants suffering from general infection of the upper respiratory tract.

Dr. L. W. Dean: It was mentioned that infants suffer from infection of the upper respiratory tract, but the infection may also be located in the ear. We work along until we see which symptoms seem to predominate. Our method of conservative treatment is with ephedrine, a 1 per cent solution of ephedrine in an oily medium thrown into the nose from a nebulizer. The dose is applied; then one waits twenty minutes, as it takes that length of time for the turbinate tissue to shrink. The oil will then come in contact with the ostium of the sinus. Five per cent solution of mild silver protein is dropped into the nose. We use the fine loop used by ophthalmologists. One can see the sinus open up. Sinusitis, with the closing of the ostia, is often associated with nephritis.

Dr. Harris P. Mosher, Boston: There has not been a subject in otology in recent years that has worried me more than the subject under discussion. I started as a doubter. This paper is the clearest and the most concise paper I have heard on the subject. The old time perspective is coming back. In the heat of the discussion in answer to a question by me it was said that the operator would operate without any signs in the drum or in the mastoid. I attribute that answer to the heat of the discussion.

Dr. Robert Sonnenschein, Chicago: At the Michael Reese Hospital there is an excellent staff of pediatricians. A number of these physicians went to the St. Louis meeting, and became so enthusiastic about the results of operations on the mastoid of infants that they came back and wanted to operate on all the infants who showed any gastro-intestinal symptoms. I believe the otologist should decide on the indications for operation. We allowed ourselves to be swayed in eight cases in infants, aged 2 weeks or older, and although we could not find any symptoms, they insisted that we should operate. One child died three weeks later. Another child, who had not shown signs of involvement of the mastoid, died, and at autopsy pus was found in both mastoids. We must get back to first principles. As Dr. Mosher says, in enthusiasm, the pendulum swings too far. Later a happy medium is reached. We want judgment based on experience in order to know what to do.

Dr. L. G. Richards, Boston: I have felt doubtful about these things. We have had experience with twelve cases, with anhydremia, vomiting, loss of weight, and I was anxious to do what I could. We attempted to carry out this technic,

watching the drums carefully. In infection of the middle ear the drums were incised, and a special chart was kept of the condition of the ear. We did everything we could for the ear infection. We did one operation on the mastoid under Dr. Dean's technic. Yet, out of the twelve cases, only one patient lived. There seemed absolutely no relation between the child's condition and the operation. There was no increase in weight or change in temperature that could be demonstrated as having relation to what we did to the ear. We may have missed conditions of the sinus, because our attention was centered on the condition of the ear, but we had an identical group of cases. We did not get the improvement we hoped when the mastoids contained pus. I think in view of the child's lowered condition that the mastoid infection existed as the result, not the cause. This fall I shall operate on such children earlier.

Dr. Ewing W. Day, Pittsburgh: In the first place, if the paracentesis is performed by the pediatrician, it should always be made upward and forward of the external canal; otherwise it is of no value. In the second place, repeated paracentesis is evidence that the infection is above in the attic or the antrum. And in the third place in postmortem examinations on children or infants one will find fluid in the antrum a few hours after death, and always after twenty-four hours.

Dr. Richmond McKinney, Memphis, Tenn.: I take an opposite standpoint from that of Dr. Richards. I thought I had overlooked something. In the Children's Hospital at Memphis, I had five cases in which double myringotomy was performed. These cases were negative as far as the roentgenogram was concerned. The roentgenogram of the mastoid was unconvincing, while the cases were clinically positive. I performed four operations on both mastoids, and one on one mastoid under local anesthesia; I used local anesthesia to avoid respiratory trouble. There was no evidence of pain. One child went to sleep under the local anesthesia. I believe that if a transfusion of blood is given before and after operation the majority of patient can be saved. It will tide the children over. I am pleased to say that our mortality rate was not so high as in Dr. Richard's cases, but his were more severe.

Dr. Edmund P. Fowler, New York: This discussion should not end without calling attention to one point, and that is the effect on the hearing in these infants. It is my belief, from the study of school children, that deafness often begins early; what kind of cases progress to deafness we do not know. There is a logical reason for some of the cases of deafness in later life. Chronic suppuration may be going on without pain, and notice may not be taken of it. A reaction occurs to the chronic inflammation. Fibrosis and tissue formation occur after the suppurative process. Possibly the nutrition necessary for the normal growth of bone in the labyrinthine capsule is affected. All these results seem to be due to chronic inflammation. I think this is important, and some day we shall be able to prevent these cases of chronic deafness by early treatment.

Dr. Burt R. Shurly: It would be remarkable if the Otological Society had to tell the pediatrician how to feed his patients so that he could prevent mastoiditis.

Dr. H. W. Lyman: I have tried to limit this paper to the consideration of the mastoid aspect of this problem. We examine the nose and throat as carefully as we know how, because omission of such an examination is like looking at one ear and not at the other. These cases are more frequent in poorly nourished, poorly fed children. Healthy, normal infants are not often subject to ear infections. Preventive measures should start prenatally. Proper feeding and proper hygiene will prevent most of these cases. In answer to Dr. Stucky, we do not use

the blood clot dressing because of the intensity of the infection in these cases and because of our desire to maintain adequate drainage. If the antrum is allowed to close too early there may be recrudescence of symptoms and it will have to be reopened. We maintain the antrum wide open until all discharge through the canal has ceased. I think the use of the screen might be practicable because the ear is painful, and it is hard to keep a bandage on these infants. There seems to be an impression in some quarters that we operate without otologic symptoms at the dictum of the pediatrician. We always have definite otologic symptoms which justify this operation. In many cases we urge operation because of the otologic condition, even when the general condition is fairly good.

Dr. McCuen Smith must have misunderstood me, as I distinctly stated that we do not operate without otologic indications.

In regard to general anesthesia, most of the infants have been in poor general condition and are not good operative risks. Many have bronchitis, or frank lobar pneumonia. We have felt that local anesthesia was safer than general anesthesia. The use of the term, "paracentesis," is loose. The only paracentesis we use is incision of the drumhead, extending to the wall of the canal. I have avoided any statistical reference because statistics based on a few cases are not only valueless, but misleading. Pus found ante mortem cannot be due to postmortem decomposition. In Dr. Richards' cases I cannot offer him any help, but will urge him to keep on. Success has increased as the work has been continued. Some infants have infection of the sinus as well as of the mastoid. One such case went to a fatal termination. Dr. McKinney spoke of transfusion. We use that preoperatively and postoperatively. If the infant is in a serious condition, preoperative transfusion is given as a routine measure. We also give saline solution and Ringer's solution. I recognize the importance of diet. The diet of these infants is most carefully supervised in regard to vitamins. Some patients do not come from the poorer districts. They come from good homes, but even the private patients are undernourished, underweight and not good nutritional subjects. I wish to thank Dr. Fowler for emphasizing the hearing phase of this question.

THE VALUE OF OXYGEN FOLLOWING BRONCHOSCOPY IN CHILDREN *

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AND
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ROCHESTER, MINN.

Bronchoscopy in children is always a major procedure, especially if a foreign body is to be removed. Two factors that especially add to the danger of such an examination are laryngeal edema and bronchopneumonia. While the skill and care of the operator may reduce this danger, it is always present. Experience teaches that laryngeal edema occurs even when the most skilled operator performs bronchoscopy, and that it cannot be foretold in which cases it will develop. It may occur when the least difficulty has been experienced in introducing the bronchoscope and when the operation has been performed with the greatest dexterity. On the other hand, in cases in which one would be most likely to expect edema because of trauma or difficulty in technic, it may not develop. Bronchopneumonia may occur concomitant with laryngeal edema or independent of it. It usually occurs in cases in which vegetable foreign bodies have been inhaled, especially if they have been present in the lung for an appreciable period.

The customary treatment in laryngeal edema is tracheotomy. To obtain the most satisfactory results, the operation should be performed early. In many cases edema may not develop, or only a minor degree may develop and subside without further trouble. In this type of case, tracheotomy is not necessary. The natural tendency and inclination of the bronchoscopist is to avoid tracheotomy if possible; but in endeavoring to do so, he frequently delays too long, and by the time it is performed, bronchopneumonia or pulmonary edema has developed.

The pathologic process that usually obtains in laryngeal edema is about as follows: The laryngeal hiatus is narrowed, due to edema of the tissues chiefly from trauma, and increased respiratory effort is necessary to supply sufficient oxygen. The increased effort to breathe induces a greater variation than normal between the negative and the positive pressure in the terminal bronchi, which tends to produce a condition of edema the walls of the fine ducts or alveoli. Slight edema in the walls of either the fine ducts or the alveoli, even before any excretion of fluid has taken place, will impede the passage of air in and out of the deeper air sacs

* From the Division of Medicine and the Section on Clinical Metabolism of the Mayo Clinic.

as well as decrease the rapidity of diffusion of oxygen through the lining membrane to the blood, thereby causing decreased oxygenation of the blood, which produces a condition of cyanosis. Cyanosis in turn has a tendency to aggravate the foregoing complications, so that a vicious circle is soon formed. If a foreign body has been inhaled, bacteria are usually present and tend to develop rapidly in the splendid medium prepared for them. This condition produces bronchopneumonia, which in turn aggravates the vicious circle by increasing the anoxemia.

Tracheotomy does not always save the life of the child. Since the tendency is to avoid tracheotomy if possible, it occurred to us to try the oxygen chamber in an effort to break the vicious circle by decreasing the labored breathing and by supplying air rich in oxygen, which likewise, because of its increased tension, would pass through the edematous mucous membrane more readily, thereby decreasing the cyanosis and tending to reduce the edema; this in turn minimizes the danger of bronchopneumonia.

Although we have not used oxygen in enough cases to warrant definite conclusions, we believe that its great value in three of our cases justifies reporting them. A more complete discussion of the subject, including reference to the literature, is given in the paper by Boothby and Haines.[1]

REPORT OF CASES

Case 1.—A boy, aged 13½ months, three days before admission to the Clinic, choked on a piece of popcorn, following which cough and wheezing respiration developed. On the afternoon of the third day, the temperature was 102 F., and the family physician made a diagnosis of obstruction of the left lung. The child was brought to the Clinic immediately.

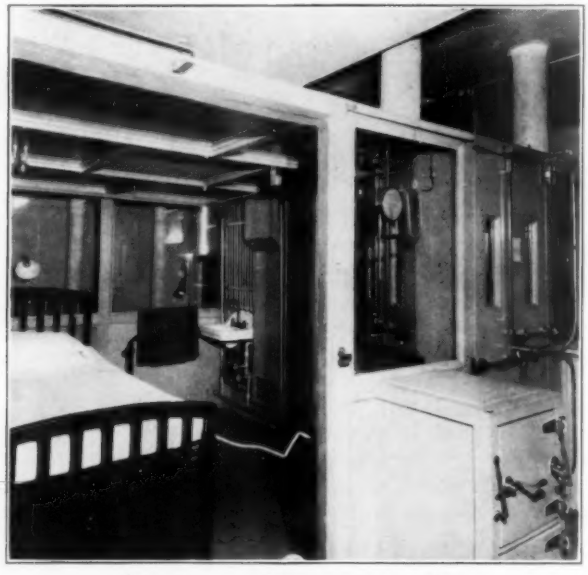
Because of the evidence of obstruction of the left bronchus, bronchoscopy was carried out without anesthesia, and a kernel of popcorn lodged in the left main bronchus was removed without difficulty. The child did well during that day, but the same evening edema of the larynx and cyanosis developed. At this time, signs of bronchopneumonia were definite over the entire upper part of the left lobe; this was confirmed by roentgenograms. The child appeared extremely ill. He was placed in the oxygen chamber, and by the next day was breathing easier and looked much better. There was no evidence of the extension of the pneumonic process. The laryngeal edema rapidly subsided, and within four days the pneumonic inflammation was nearly resolved, and the child was permitted to leave the hospital.

Case 2.—A girl, aged 15 months, had aspirated a piece of egg shell five days before she was admitted to the Clinic. On the preceding day the family physician had attempted to remove the foreign body under general anesthesia, without success.

The child was markedly dyspneic and cyanotic and had a paroxysmal cough. On bronchoscopic examination, without anesthesia, a piece of egg shell was

1. Boothby and Haines: Oxygen Therapy, to be published.

seen projecting between the cords. The shell was extracted with some difficulty, but following the procedure she breathed much easier. The same afternoon, tracheotomy was deemed necessary because of dyspnea and beginning cyanosis due to laryngeal edema. However, even after tracheotomy and repeated aspiration, the thick tenacious mucus had a tendency to obstruct the tube, and with this there was pulmonary edema. The child's condition was grave, and she was placed in the oxygen chamber during the night. Improvement was immediate. The next day she was breathing easily, and the temperature that had been 102 by rectum the day before was normal. Without the use of oxygen, in spite of tracheotomy, the child would undoubtedly have died, as she was unable to get sufficient air through the tracheotomy tube and past the thick tenacious mucus.



Appearance of oxygen chamber.

CASE 3.—A boy, aged 4 years, had inhaled a peanut two weeks before admission to the Clinic. He had not had appreciable trouble until after the first five days, when dyspnea and cough developed. Two days before admission, bronchoscopy was performed elsewhere, without success.

The child was extremely dyspneic and cyanotic. The left side of the chest was markedly retracted, and there were definite signs of decreased aeration of the left lung. The condition was serious, and tracheotomy was performed at once; there was prompt improvement, although the evidence of an obstruction of the left side of the lung persisted. The patient was placed in the oxygen chamber, and the following day he appeared well enough to be removed. However, within two hours, he again became dyspneic and cyanotic, and the temperature rose from normal to 105. He was returned to the oxygen chamber immediately, and again improvement was marked. This demonstrated that the child could tolerate a lower oxygen tension for a short time. Arrangements were therefore made to return him to the oxygen chamber following bronchoscopy, which was performed the following morning. The peanut which

obstructed the left bronchus was removed. A large amount of pus was found exuding from all the bronchi of the left lung. As much of it as possible was aspirated, and the child was returned to the oxygen chamber. The temperature returned to normal the following day, and the pneumonia in the lower portion of the left lobe rapidly disappeared. We believe that this child's life was probably saved by the use of the oxygen.

COMMENT

In view of our experience with these three patients, we believe that it would be well to place all children in the oxygen chamber immediately after bronchoscopy, in order to decrease the labored breathing, to reduce cyanosis, to prevent edema as much as possible, not only of the larynx but also of the respiratory membrane, and to reduce the possibilities of the occurrence of bronchopneumonia by keeping the patient in the best possible condition to prevent its development. Oxygen should be used, especially if laryngeal edema is marked and if pneumonia has developed, as it puts the patient in a better condition to overcome injury. If an oxygen chamber is not available, oxygen might be given through a portable oxygen tent or through a catheter, although the latter methods are usually inefficient and hard to carry out if the child is restless.

RELATIONSHIP BETWEEN MUCOCELES AND CYSTS

REPORT OF A CYST OF THE MAXILLARY SINUS*

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There is a prevailing conception that a mucocele is caused by the occlusion of the ostium of a sinus. A gelatinous material is supposed to accumulate within the sinus. The subsequent rise in the intrasinus pressure is said to cause degeneration and absorption of the walls of the sinus.

The clinical and pathologic features of a mucocele are indisputable. It is doubtful, however, whether occlusion of the ostium is the only factor in the production of a mucocele. It is not unlikely that some type of cystic degeneration of the mucosa precedes the mature and classic mucocele. It must have a favorable soil for its origin. According to this conception, both factors, cystic degeneration and ostial occlusion, are essential to the development of a mucocele. A cyst may grow until it fills the capacity of a sinus without producing a mucocele, as long as the ostium remains patent. Similarly, occlusion of the ostium without a tendency to cystic degeneration of the mucosa will not cause a genuine mucocele.

Certain clinical phenomena speak in favor of this hypothesis:

1. If blocking of an ostium without the aid of other factors were responsible for mucoceles, this condition would be encountered more often. Although there are many instances of ostial occlusion resulting from hypertrophy, hyperplasia, polypoid changes and neoplasmic growths, nevertheless, mucoceles are comparatively rare.

2. There are instances in which, during the course of the routine roentgen-ray examination of the sinus, a mucocele is discovered in its incipient stage. When the frontal sinus is trephined one invariably finds a cystic mass in the floor of the sinus in the immediate vicinity of the orifice of the nasofrontal duct. If this mass were not removed at this early stage, it would undoubtedly expand in all directions within the sinus; the ostium would become occluded and finally a mucocele would develop.

3. The relative frequency of the appearance of mucoceles in the frontal as compared to the maxillary sinuses, points to cystic changes as a primary factor. The floor of a sinus is subject to greater irritation as a result of gravitation and accumulation of products of inflammation, bacteria and toxins in this region. This makes the floor a most favorable

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* Presented in part at the April Meeting of the Lebanon Alumni Society.

soil for cystic changes. A cyst growing in the floor of the frontal sinus has a better chance to be converted into a mucocele than in the maxillary sinus, because the ostium of the former opens in the floor, while that of the latter opens in the roof of the sinus.

4. According to Smith,[1] Hajek [2] and others, pain is characteristically absent in a mucocele. On the other hand, ostial occlusion is known to be

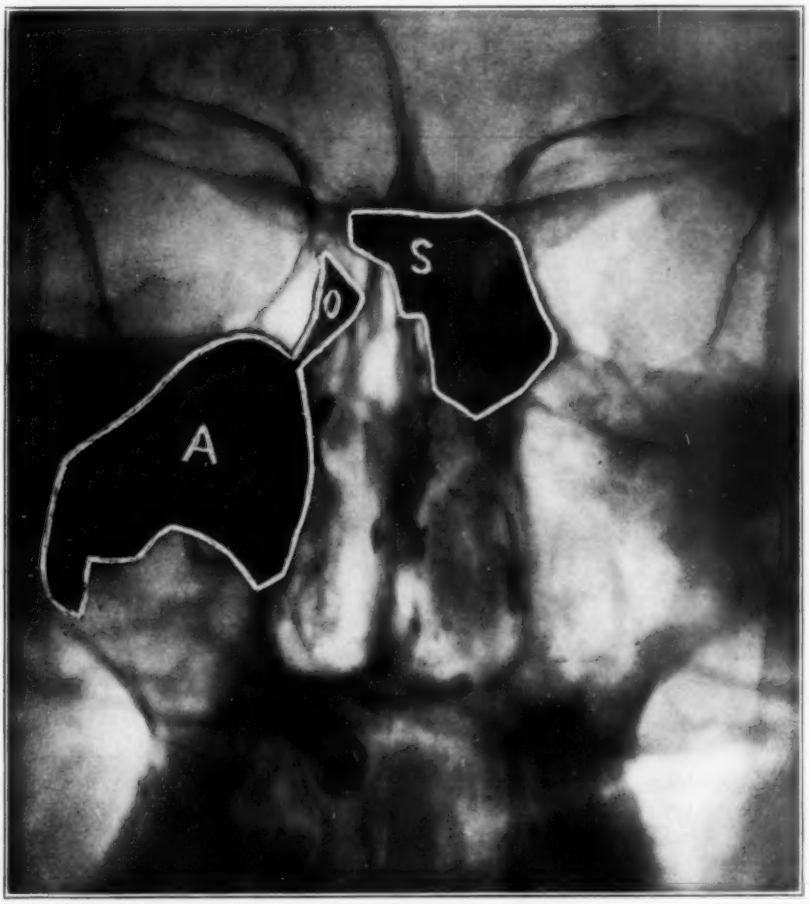

Fig. 1.—Roentgenogram showing the postero-anterior view of the sinuses after the injection of iodized oil 40 per cent into the right antrum and the left sphenoidal sinus. *A* shows an incomplete filling of the antrum. The oil is floating on top of the cyst. Note the irregular outline of the oil. *O* shows the escape of the oil from the antrum through the hiatus semilunaris and middle meatus; *S*, the outline of the sphenoidal sinus showing asymmetry.

1. Smith, Harmon: Diseases of the Nose and Throat, Philadelphia, Lea & Febiger, 1914, p. 190.

2. Hajek: Nasal Accessory Sinuses, Heitger Hansel English Translation, vol. 2, St. Louis, C. V. Mosby Company, 1926, p. 360.

a painful condition. Sluder [3] stresses particularly that the "vacuum headache" is caused by ostial occlusion. If ostial blockage were a primary factor in mucoceles, one should expect a definite history of pain occurring synchronously with the event of occlusion. The theory of primary cystic degeneration can explain the absence of pain satisfactorily. Since the stage of occlusion is preceded by degeneration of the mucosa, the nerve terminals lose their sensitivity for the perception of pain stimuli.

The practical importance of this contention is obvious. It points to the way of prophylaxis, namely, the removal of the mucocele in the

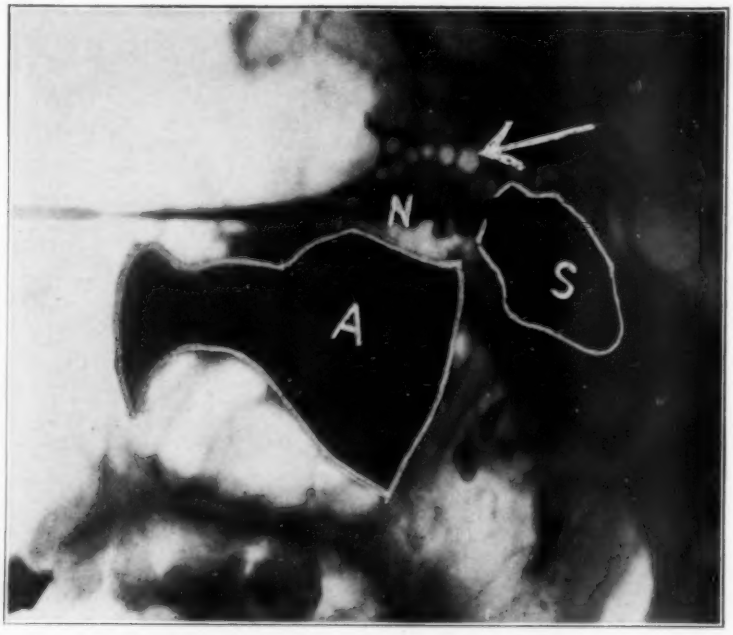

Fig. 2.—Roentgenogram showing a lateral view of the sinuses after the injection of iodized oil, 40 per cent. *A* shows the oil floating on top of the cyst which is conical; the larger end begins anteriorly; *S* is the sphenoidal sinus; *N*, the needle showing how the guard stops the needle at the anterior wall of the sphenoid. The arrow points to a series of air bubbles escaping from the sphenoid when the oil entered. The injection into the sphenoid was for experimental purposes and bears no relation to the case report.

cystic stage before extensive damage has taken place. This can be accomplished by employing the roentgen-ray as a routine in the examination of sinuses.

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3. Sluder, Greenfield: Headache and Eye Disorders of Nasal Origin, St. Louis, C. V. Mosby Company, 1927, p. 31.

As an illustration of the value of early roentgen-ray diagnosis in cysts of the nasal accessory sinuses, the following case is reported.

REPORT OF A CASE

History.—E. K., a woman, aged 25, a houseworker, born in Germany, was admitted in March, 1927, to the Manhattan Eye, Ear and Throat Hospital on the service of Dr. John E. MacKanty, under my care. The family and previous history were irrelevant. Six weeks prior to admission, her complaints started with a mild, supra-orbital headache on the right side. It occurred at irregular intervals day or night and was somewhat aggravated by stooping and hard work.

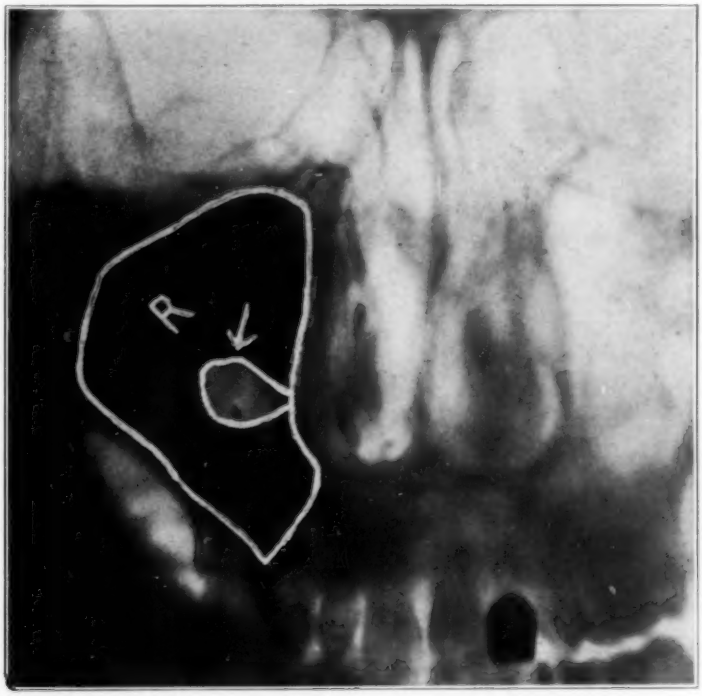

Fig. 3.—Roentgenogram showing the anterior view of the right antrum. Iodized oil 40 per cent was injected into the cyst by puncturing the antromeatal wall close to the floor of the antrum. The arrow points to an area of incomplete filling of the antrum which was prevented by the gelatinous material within the cyst.

She experienced moderate nasal obstruction, which alternated from the right to left side, but there was no discharge or olfactory disturbances.

Examination.—The patient appeared to be healthy. Anterior rhinoscopy revealed a moderate generalized turgescence of the mucosa in both nasal fossa. The color was pinkish; the moisture was normal. The right inferior turbinate was somewhat larger than the left. The middle turbinates could not be seen until the mucosa was shrunk. The septum was thickened throughout with a slight deviation to the right in the region of the middle turbinate. Posterior

rhinoscopy revealed nothing abnormal. Puncture irrigation of both maxillary sinuses gave a clear return flow. The blood Wassermann reaction was negative. The essential part of the roentgen-ray report by Dr. Frederick M. Law, stated that in the postero-anterior view there was an outline of a body in the right maxillary sinus. Its upper boundary was irregular in the transverse diameter. It did not present the usual density of a polyp.

Equal parts of iodized oil 40 per cent and peanut oil were injected into the right maxillary sinus by inserting a straight trocar at the highest point of the inferior antromeatal wall (figs. 1 and 2). A large mass was seen in the lower part of the sinus. It was translucent as compared to the upper part and was pear shaped with the tail directed posteriorly.

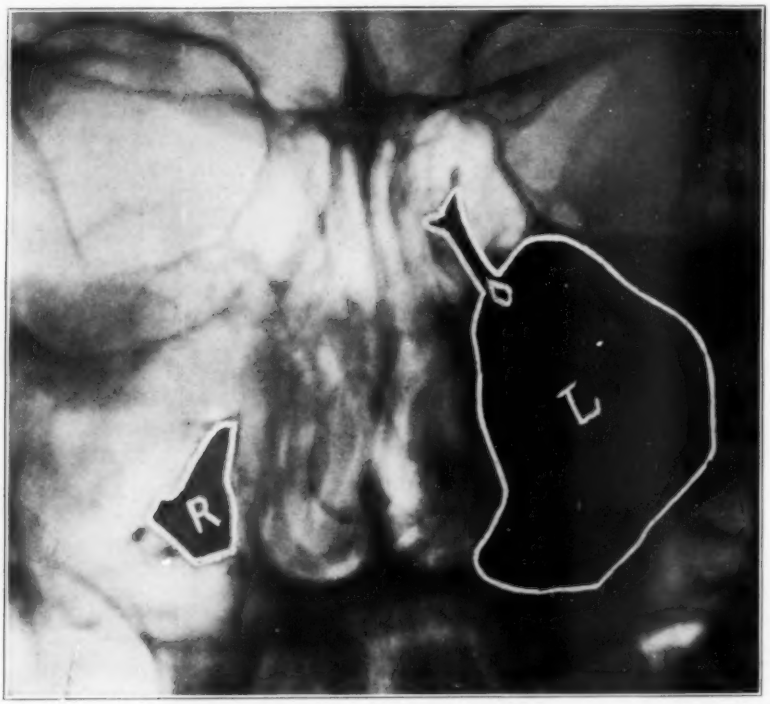

Fig. 4.—Roentgenogram showing a postero-anterior view of the sinuses. *R* is the right antrum one week after the injection of iodized oil, 40 per cent, showing some of the oil was trapped by the cyst. *L* is the oil injected into the left antrum showing normal complete filling; *O* shows the escape of the oil through the ostium maxillaris and the hiatus semilunaris.

Five days later, iodized oil, 40 per cent, was again injected into the right maxillary sinus, but the trocar was introduced this time through the lowest level of the antromeatal wall (fig. 3). The oil filled the entire sinus, except a small area, midway and close to the meatal wall.

What actually happened during the second puncture was that the trocar entered the cyst and the cystic fluid escaped through the ostium. The iodized oil replaced the fluid and compressed the walls of the sac into a lump represented by the area of the filling defect.

One week later, iodized oil was injected into the left maxillary sinus, and the roentgenogram showed that this sinus was normal (fig. 4). Some of the oil was trapped within the cyst of the right maxillary sinus, which was injected one week previously.

Treatment.—A Cauldwell-Luc operation was performed under ether anesthesia. A large collapsed cyst was found attached to the floor of the right maxillary sinus. The alveolar region was palpated for exposed or protruding dental roots, but none were found. This was done in order to exclude the possibility of this cyst being of dentigerous origin.

Pathologic Report.—The cystic wall was examined by Dr. A. A. Eggston. He reported that this was a mucomembranous cyst. The epithelium was of the stratified columnar type.

The patient made a rapid and uneventful recovery. All the symptoms disappeared promtly.

1420 Grand Concourse.

CARTILAGE AND IVORY IN PLASTIC SURGERY OF THE NOSE*

SAMUEL SALINGER, M.D.
CHICAGO

In discussing the use of implants as supporting materials for the reconstruction or alteration of the shape of the nose, it is not so important to know what the personal likes and dislikes of the surgeon may be as it is to determine, if possible, which method and what material is best for the patient. It is difficult, however, to arrive at a decision, because few operators have had a wide enough experience with a sufficient variety of the numerous materials proposed to enable them to make adequate comparisons. Unprejudiced opinions, however, when based on even a limited but careful observation, if accumulated from reliable sources, may help materially in determining one substance which may be accepted as preferable to the others for this kind of work. The ideal material would be one that is readily obtainable, easily shaped, would not change in the course of time and would be tolerated by the recipient tissues.

My own experience is based on the use of both costal cartilage and ivory in similar cases, the results being compared on the basis of the ideal requirements just enumerated.

I have found costal cartilage a splendid material for implantation to restore the contour of the nose. It is readily obtainable from the right seventh to the tenth ribs in quantities sufficient for all ordinary needs without any danger of impairing the integrity of the wall of the chest. It is not necessary to remove the entire thickness of the rib, although by taking one border of it one may in some instances find it easier to cut the necessary triangular shape in situ. It is important to remove a long enough piece in the first place so that the shaping may be done without cutting the implant down below the required size in the individual case. It is not necessary to place the cartilage in any solution pending closure of the wound in the chest; merely wrapping it in sterile gauze is sufficient. The technic of excision of the cartilage will not be considered here, as it may be found described in detail in the works of Joseph, Sheehan and others.

It is extremely important to remove every vestige of perichondrium from the implant, except when an angle is desired for supporting the tip of the nose, as the cartilage will bend in the direction of the perichondrium, thus spoiling the straight line which is sought. Fre-

* Read before the Chicago Laryngological and Otological Society, Jan. 3, 1927.

quently one finds the perichondrium so thick and so densely attached that it is necessary to pare off a thin strip of cartilage with it.

I prefer the median columnar incision, because it eliminates every possible contact with the mucosa and enables one to insert the implant through a surgically sterile field. If the wound is closed with a subcuticular horse-hair suture, the resultant scar will be so slight as to escape all but the closest inspection.

The usual lack of agreement among various observers concerning the ultimate fate of the implant is found in the literature. Some claim that the cartilage is gradually absorbed and that, in many instances, it is replaced by dense fibrous tissue which all but serves the original

Fig. 1.—Saddle-nose corrected by costal cartilage implants.

purpose. Others contend that the implant retains its vitality, receiving nourishment through the lymphatics and blood vessels of the surrounding tissues. It has been generally accepted on the basis of the older teachings that blood vessels are rarely found within the structure of cartilage; yet two Russian observers, Popoff and Linburg, are quoted by Bourack,[1] as having frequently demonstrated small vessels. The latter also found a marked division of opinion among a large number of writers concerning the ability of cartilage to survive when deprived of its perichondrium. I have had only one opportunity to examine

1. Popoff and Linburg, quoted by Bourack: Ztschr. f. Hals-, Nasen- u. Ohrenh. **11**:451, 1925.

transplanted cartilage histologically. This was removed at autopsy from the body of a patient who died of an intercurrent disease. Figure 8 shows the implanted cartilage securely enveloped in dense fibrous tissue which has grown into a crevice between two implants and also into an artificial crack, probably caused by the paring knife in the original shaping of the implant. It shows further the denser structure of the costal cartilage as compared to the adjacent nasal

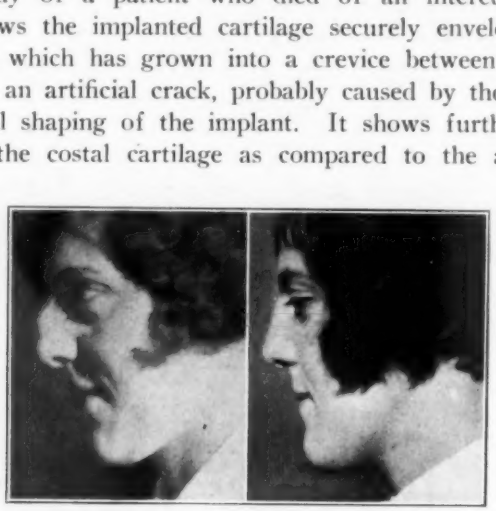

Fig. 2.—Hump removed by saw and rasp. Depression filled in with costal cartilage.

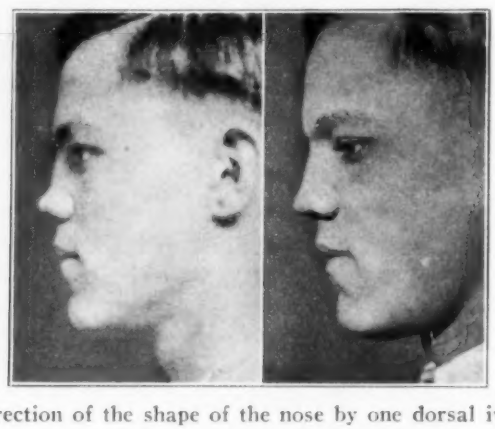

Fig. 3.—Correction of the shape of the nose by one dorsal ivory implant.

cartilage, and the difference in the shape and arrangement in the cells. These cells are still viable after four months, which speaks well for the vitality of the cartilage. This is evidence that the implant is not the foreign body, and if similar observations are made with the same results at a later period, they will go a long way toward establishing the supremacy of cartilage as a live implant.

Besides the statements previously alluded to bearing on the eventual absorption of implanted cartilage, there are other objections to its use. The most important of these has to do with the surgical procedures

necessary for obtaining the cartilage. A fairly large incision is required, with cutting of the fascia and sometimes of the muscles. There is always some risk of infection, frequently through no fault in the technic. This happened in one of our cases in which imperfect catgut caused a deep infection that came to the surface after two weeks and drained for over a month. One has also to consider the objection to a permanent scar. How much simpler, then, it is to use a foreign substance, such as parffin, celluloid or ivory. Encouraged by flattering reports concerning the value of ivory, my co-workers and I have attempted its use during the past year in cases in which we formerly employed cartilage, and we have been astonished at the immediate results. The tissues seem to tolerate it with but little reaction. There is only a transient swelling of the overlying skin and scarcely any redness. Pain is entirely absent, except when the end of an implant is

Fig. 4.—Correction of the shape of the nose by two interlocking ivory implants.

pressed against contiguous bone. It possesses an enormous advantage from the patient's point of view, because the actual insertion of the ivory is a comparatively simple and brief procedure. The greater part of the work, and the most important, is done long before the surgical operation; namely, the cutting and shaping of the ivory. Our usual procedure is to take a plastic impression of the face, from which a model is made, either in plaster or wax. A block of ivory is then cut by means of a jig saw and is shaped on a grindstone, which can be attached to almost any small motor. With the plaster model as guide, it can be accurately shaped, and when finished can be smoothed and polished by sandpaper disks attached to a dental cable. This is so much easier and more satisfactory than the cumbersome files proposed by Joseph. With small dental drills, one can bore numerous holes through the piece of ivory, which will lighten it and may also serve for the growth of fibrous trabeculate from the surrounding tissues. It is then sterilized by boiling.

The insertion of the ivory is simple. After injecting the columella and from it the tissues over the dorsum with 1 per cent procaine hydrochloride, a median vertical incision is made through the columella, and the soft tissues of the nasal dorsum are elevated by dull scissors or a septal elevator. To prevent slipping of the implant after it has been placed, one should be careful to elevate only as much of the tissues as is required to hold the ivory. In cases in which the tip of the nose is depressed

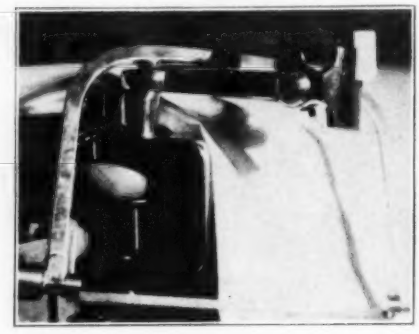

Figure 5

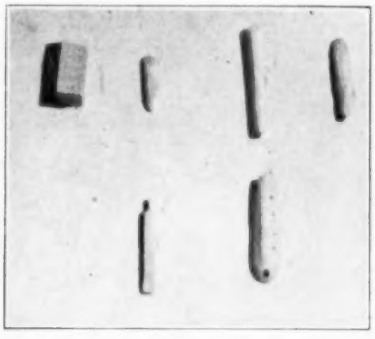

Figure 6

Fig. 5.—Vise holding block of ivory. Jig saw for cutting ivory.

Fig. 6.—The lower two pieces are the columnar and dorsal implants for a flat nose.

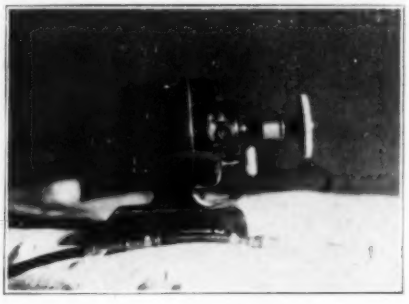

Fig. 7.—Motor with stone for grinding down the ivory. Dental cable with carborundum disk for smoothing implant.

through loss of septal cartilage, it is necessary to introduce a strip of ivory into the columella to prop up the dorsal piece and to hold up the cartilaginous nose. In order to retain this columellar implant, we cut its upper end down to a small peg, which is fitted loosely into a hole drilled into the lower end of the dorsal implant. This holds the two together and allows sufficient play for the usual movements about the end of the nose. The length of the columellar piece is estimated by

measuring the distance from the root of the anterior nasal spine to the tip of the nose after it has been temporarily lifted to the desired height. The incision in the columella need not be more than from 1 to 1.5 cm., which affords sufficient access to the soft tissues of the membraneous septum, as these are opened down to the nasal spine to provide a bed for the columellar ivory. The dorsal ivory is inserted first; then the maxillary end of the columellar piece is pushed down into the prepared bed, and its upper end (the peg) is slipped into the hole at the lower end of the dorsal portion. A mattress suture may be placed through the membranous septum behind the columellar piece if there seems to be too much play.

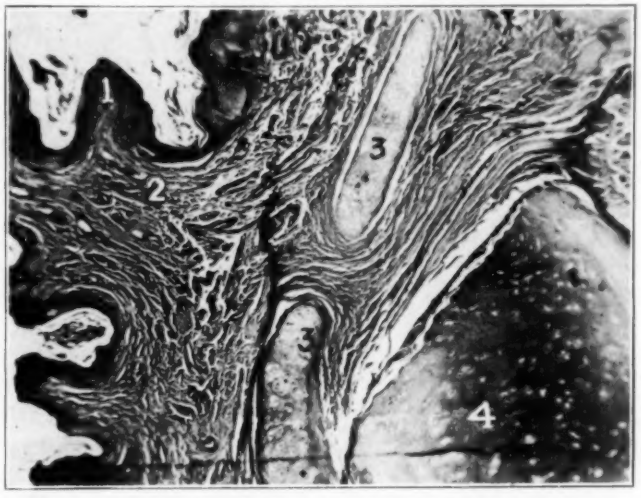

Fig. 8.—Number 1 indicates the nasal mucosa; 2, the submucosa; 3, the upper lateral nasal cartilage, and 4, the costal cartilage implant.

COMMENT

We have operated on several patients in cases of this type, and up to the present have found that the implants are well borne. It is important to avoid distending or stretching the tissues. We have found that the only point at which pain may be elicited is at the nasal spine, against which the columellar implant rests. This, however, tends to become less pronounced as time goes on.

Cases of extrusion of ivory implants have been reported some time after operation, but in nearly every instance the operation has been performed through an intranasal incision. It is our belief that bringing the ivory too close to the surface of a mucous membrane has been the responsible factor. Mucous and submucous tissues are not dense enough to resist the constant pressure of a hard substance like ivory.

For this reason, as well as on account of the lesser likelihood of infection, we employ the skin incision through the columella, for here it is possible to avoid the surfaces of the mucous membrane and to introduce the ivory through tougher tissues into its fibrous bed, where it is best tolerated.

For the time being, we are inclined to favor ivory over cartilage for the repair of saddle-noses, or flat tips, because it is easier for the patient, there is less chance of infection, and the ivory will not be affected by the host. Whether or not the converse of the latter is a fact, remains to be seen. At the present time, implants inserted more than a year ago are securely in place, the surrounding tissues do not show any sign of ejecting the stranger and the cosmetic results are ideal. Should the conditions remain undisturbed for a longer period of time, I may feel more secure in the hope that an ideal material for nasal implantation has been uncovered to take the place of costal cartilage.

ACUTE FULMINATING OSTEOMYELITIS OF THE FRONTAL SINUS

HEMATOGENOUS (?) ORIGIN (DENTAL FOCUS) REPORT OF A CASE *

HILL HASTINGS, M.D.
LOS ANGELES

The uncertainty of the etiology, the acute onset, the rapidly developing meningeal symptoms and the rapid improvement and self-limitation prompt me to report this case of acute osteomyelitis of the frontal sinus.

Before reporting the case, I should like to present certain questions that have arisen in the study of osteomyelitis. The reported cases of acute osteomyelitis have usually been those of fulminating diffuse osteomyelitis, originating in the frontal sinuses but gradually spreading without being self-limited. That self-limited frontal osteomyelitis does occur is evident from both surgical and pathologic experience. It has not been explained why it becomes diffuse and fatal in relatively few cases.

The comparison of osteomyelitis of the paranasal sinuses with osteomyelitis of the long bones is interesting because of the striking diversity. In all the reported cases with one exception,[1] acute fulminating osteomyelitis of the paranasal sinuses that is diffuse in character is attributed to a contiguous focus of infection, whereas in osteomyelitis of the long bones the focus is nearly always far distant. The orthopedic authorities look for a hematogenous route of infection in almost all cases; for example, infected tonsils and teeth. Almost without exception, the cases of nasal disease are reported as being due to direct spread of infection from the infected mucous membrane of the sinuses. In the case I am reporting, while a direct spread of infection is more plausible, the hematogenous route should not be overlooked as a possibility. This view was forced on me by the absence of all signs and symptoms of an acute nasal infection and by the fact that there was no history of chronic nasal disease. The toothache was the initial and the only sign of a focus of origin. Serious symptoms followed almost immediately.

Acute diffuse osteomyelitis of the paranasal sinuses presents other striking differences from that of the long bones; for example, in the age of the patient. McKenzie [2] finds only two cases in patients under

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* Read at a meeting of the American Laryngological Association, May 23, 1927.

1. Bulson, A. E., Jr.: Osteomyelitis of the Frontal Bone as Complication of Frontal Sinusitis, J. A. M. A. **86**:246 (Jan. 23) 1926.

2. McKenzie: Laryng., Jan., 1913.

10 years of age. On the contrary, acute osteomyelitis of the long bones occurs in children, as a rule. Injury, of course, is the forerunner of acute osteomyelitis of the long bones. No bone in children is more exposed and receives more trauma than the frontal bone; nevertheless, acute osteomyelitis is rarely if ever seen following the ordinary bruise of the forehead in children. Scheinzeis states that in a series of 1,782 cases of acute osteomyelitis of the long and flat bones, in only ten were the cranial bones affected. It is possible that one must look to the study of the development of the long and flat bones and their blood supply to explain why a spontaneous osteomyelitis of the flat bones so seldom occurs. Infection through the blood stream, it is said, is more apt to occur in the long bones than in the flat bones because of the difference in the blood supply. In flat bones the circulation is from the periosteum of both surfaces, without any well developed single nutrient artery, as is found in the epiphysis of the long bones. In the latter case, an embolic blocking of one of the divisions of the nutrient artery is more apt to result, whereas in the flat bones the periosteal circulation possesses so many portals of entry and such free anastomosis that death of tissue from an embolus is unlikely. Robertson [3] reaffirms the orthopedic belief that the acute osteomyelitis in children begins at the junction of the epiphysis to the shaft and spreads up the shaft and not into the joint. Furthermore, his experimental studies with injections of staphylococci into the blood stream in animals show a pronounced phagocytosis in the medulla of the long bones, the resulting infection localizing in the surrounding bone plate and not in the medulla. In children, the epiphysis is still unfused to the shaft, and injury is therefore more liable to occur. The absence of a true epiphysis in the frontal bone, as in other flat bones, may have some bearing on the rarity of acute osteomyelitis of hematogenous origin.

When attention is turned to the paranasal sinuses, the frontal sinus stands almost alone in the record of reported cases of acute osteomyelitis. In his study of the literature, McKenzie finds forty-two diffuse forms originating in the frontal bone, three in the antrum, and none in the sphenoid. An adequate explanation has not been given for this striking diversity.

Operative trauma resulting from radical operations for the cure of chronic suppuration of the frontal sinus may explain most of the cases of acute osteomyelitis. In his search of the literature covering thirty years, Bulson [1] reports fifty-five cases of acute diffuse osteomyelitis, with thirty-seven deaths. Twenty-eight of the cases occurred as compli-

3. Robertson, D. E.: Acute Haematogenous Osteomyelitis, J. Bone & Joint Surg. **9**:8 (Jan.) 1927.

cations of chronic suppuration of the frontal sinuses; twenty of these followed radical operative procedures.

In this connection, it is well to call attention to the present attitude of orthopedists in dealing with acute osteomyelitis, which differs somewhat from the past surgical procedures. They now limit surgical measures to a wide exposure, with no attempt to remove all the infected bone; this permits nature to form its barriers and by sequestration to stop the process, the sequestrum being removed later. A two-stage operation for chronic frontal suppuration, in which there is acute involvement of the bone may prevent many fatal results. In twenty-seven cases of acute osteomyelitis recorded in the literature (Bulson), the condition developed from acute suppuration of the frontal sinuses; in only three cases did the osteomyelitis develop coincidentally with the acute signs and symptoms of involvement of the frontal sinuses. Of these three cases of so-called spontaneous osteomyelitis, one occurred without evidence or history of previous nasal trouble. I am reporting such a case.

REPORT OF A CASE

J. L. G., a man, aged 30, was seen on Aug. 5, 1924. Three days previously, he awoke with a pain in the left upper molar. He consulted a dentist, who painted the gum with iodine. He went home with a headache, pounding in character; he felt feverish, and had a chill. After he went to bed, he sweated profusley and had one or more chills during the night. The next day he was drowsy and feverish, and was said to feel very sick. Dr. E. C. Fishbaugh, an internist, was called; he did not find evidence of involvement of the lungs, heart or abdomen and no sore throat or cold. The temperature was 101 F.; a little swelling was present above the outer extremity of the left eyebrow. The frontal sinus was slightly tender at that place.

On account of the soreness of the frontal sinus and the history of toothache, my associate was called. He did not find any evidence of an acute cold or any pus in the nose or swelling of the turbinates. The tonsils were small, submerged and not acutely inflamed. There was a small slough seen above the upper left bicuspid tooth, apparently the effect of the application of iodine. Pain and tenderness were present above the left eye, with slight swelling of the upper left eyelid. The temperature was 102 and the pulse rate, 64; the white blood cells numbered 17,900, with 90 per cent of polymorphonuclear cells. In a few hours, the patient had another chill and a profuse sweat. Nasal examination was repeated and did not show pus in the nose; but transillumination, made because of the initial toothache, showed a dark left antrum, which was at once punctured and some pus washed out. The patient had not had any nasal trouble. He had not had a chronic or acute nasal discharge. The finding of pus in the antrum was insufficient to account for the serious condition.

On August 5, the third day of the illness, the condition was serious. The patient was irrational at times; he was partly comatose and somewhat responsive, but apparently not mentally clear. The swelling of the left eyelids had rapidly increased and extended over the anterior wall of the frontal sinus and to the left toward the temporal region. Consultation was held by the internists, two ophthalmologists and a neurologist. The neck was slightly stiff; the reflexes in the upper extremities were not exaggerated; a suggestive Babinski reflex was

present on the left; it was negative on the right. Reflexes of the lower left extremity were markedly hyperactive as compared with the right. I had been out of town, but at this point I was called in consultation. I was unable to throw any light on the diagnosis. I did not find any evidence of acute nasal trouble or pus in the nose. There was no redness or swelling of the naso-antral wall and no tenderness over the antrum; however, acute tenderness was present over the left frontal sinus, especially above the external angular process. There was marked edema of the eyelids. Examination of the eyes by Dr. A. L. Macleish showed distinct diplopia and marked interference in vertical motion of the eyeball but not in the lateral motion. There was no marked increase in intra-ocular pressure. Spinal puncture by Dr. Hammack showed the fluid to be under considerable pressure and distinctly cloudy; the cell count was 520; bacteria were not found on the smears. A culture was made. Operation was advised with a provisional diagnosis of a possible orbital abscess, involvement of the frontal sinus and suppuration of the left antrum (based on the report of the puncture of the antrum of the day before). Apparently, meningitis had already resulted.

On August 6, the fourth day of the illness, operation was performed at 10 a. m. The patient was in a critical condition; he was partly comatose, somewhat responsive but apparently not mentally clear. An incision was made in the eyebrow for exploration of the left frontal sinus and orbit under the frontal plate. Pus was not found in the orbit; the periosteum of the floor of the orbit was rough, red and thickened. The bony floor of the frontal sinus was somewhat roughened. The frontal sinus was opened at its inner angle. Its lining membrane was pale gray, apparently not inflamed. A probe puncture through the lining membrane did not disclose pus at first; the sinus was found to be fairly large and apparently empty. The outer wall of the frontal sinus was softened, particularly at its outer angle. When the opening in the frontal sinus was enlarged, a small amount of thick fibrinopurulent pus was seen deep down around the nasofrontal duct. This pus so greatly resembled the fibrinopurulent exudate often seen at the base of a lung in acute pneumonia that I remarked that the infecting organism was probably a pneumococcus. (Cultures showed, however, a pure culture of staphylococcus.) When the small amount of pus on the floor of the sinus was wiped out, the adjacent lining membrane of the sinus, thin and apparently necrotic, peeled off. It did not present the usual appearance of an acute or of a chronic suppuration. The orbital plate was rough; the supra-orbital ridge was partly softened; the cerebral bony wall was not necrotic. A wide exposure of the frontal sinus was rapidly made and the wound loosely packed with gauze. The brain was not uncovered, as it was felt that there was no collection of pus on the brain but that the patient had an acute general meningitis and would likely die. The patient recovered from the anesthetic and was partly conscious. He had a chill at 3 p. m., and another at 3:15 p. m. The axillary temperature was 104; he was restless and answered questions rationally at times, though at other times he talked at random. The culture from the spinal fluid proved sterile.

On Tuesday, August 7, the patient had had a better night and awoke without much headache. He was rational. The neck was still stiff but was no worse than before. The knee reflexes were equal and slightly exaggerated. The Babinski reflex was negative on the right and equal on the left. The general condition was much improved. The temperature had decreased to 102; the pulse rate was low, not over 70.

On Wednesday, August 8, the patient was decidedly better; the temperature was 102.6; the pulse rate was still low.

On Thursday, August 9, the third day after the operation, the condition was much improved. The maximum temperature was 102.6; the pulse rate was low.

On August 10 and 11, the condition was gradually improving; the maximum temperature was 102.4; the pulse rate was low.

On August 12, the sixth day after the operation, the maximum temperature was 102.4; the pulse rate ranged from 60 to 70. Dr. Rand, the neurologist, reported that daily examinations had shown an improvement without definite signs of abscess of the brain and with improvement in the meningitic symptoms. Examination of the eyes on August 12 still showed some haziness of the nasal margin of the disk. The reflexes were about normal, except the left knee reflex, which was greater than the right. A definite Babinski reflex was present on the left side; the right grip was 80, the left, 85. The left side of the face was slightly weak. The stiffness of the neck had not increased nor had a definite Kernig sign developed, though both were still suggestive of an intracranial condition. The white cell count had increased to 21,000. Dr. Rand still felt that an intracranial condition was present, and that possibly an abscess was forming.

From August 13 to August 16, stereoroentgenograms of the skull showed that both antrums were dense. There was an increase in density in the lower portion of the frontal sinus on both sides. The density apparently extended into the ethmoid. The frontal sinuses were large. Marked fuzziness and lack of detail were present in the left frontal region, with some thickening suggesting an active process in the frontal bone. A right lateral stereoroentgenogram of the skull did not show definite evidence of pathologic changes in the cranial cavity.

The patient rapidly improved; the temperature came down to normal, and further operative measures were not deemed advisable.

On August 23, seventeen days after operation, the temperature had been normal for the past week. The general condition seemed about normal. Headache was not present; weakness of the left side of the face had cleared up. Neurologic examination showed that the grip was normal in each hand. All the reflexes were active and equal and apparently normal. Ankle clonus was not elicited; the Babinski reflex was absent on the right and present on the left. The neck was not stiff. The only residual symptom was a possible weak Babinski reflex on the left side. A slight hazy condition of the nasal side of the left optic disk was still present. No hemorrhage or exudate was seen in the retina. There was no elevation of the disk. The blood count had gradually come down to 12,500.

On August 29, twenty-three days after the operation, the patient left the hospital in good condition, with the wound still open and draining.

On October 15, six weeks later, signs of abscess of the brain had not developed, and the patient was in an excellent condition. The frontal sinus was still draining a considerable amount of pus. Bare bone was felt at the floor and near the opening of the nasofrontal duct. There was still a slight swelling of the left upper lid and marked diplopia. A sequestrum 1 by ½ inch (2.5 by 1.2 cm.) wide was removed during one of the dressings. It was determined that a radical operation on the frontal sinus after the Killian method should be performed in order to complete the cure.

On October 15, the frontal sinus was opened through the old scar; the incision was carried along the inner side of the orbit about 1 inch and along the nasal process. The floor of the frontal sinus was found softened throughout. The edges of the previous operative opening of the frontal sinus were badly softened and extended well out to the external angular process. The inner table of the frontal sinus was softened close to the midline. The dura was found exposed and greatly thickened, but no collection of pus was seen on the dura. Evidently

an osteomyelitis had been progressing. The Killian type of operation was abandoned. It was impossible to save the supra-orbital ridge, as it was diseased throughout, and it was removed. Several sequestrums were removed, some of them being the remains of the orbital plate and several, of the posterior plate, of the frontal sinus. Close to the midline, the remainder of the posterior plate of the frontal sinus was firm and intact. The sinus was treated by loose packing and the wound left wide open. The patient did not have complications from the operation. The temperature did not rise above 99.6. He was discharged thirteen days after operation. Convalescence was uneventful.

The antrum was never again punctured, and pus suggestive of chronic disease of the antrum was never found. There was no history of any disease of the antrum. I have seen the patient at intervals for a great many years, and have never observed any signs or symptoms of chronic disease of the accessory sinuses. The cause for the acute fulminating frontal sinusitis with rapid invlovement of the bone is still in doubt. The history of the toothache and the pus found in the antrum at the time of the onset of the symptoms of involvement of the sinus inclined us to feel that the infection in the tooth was the cause of the osteomyelitis. However, the antrum and cheek were not involved, only the bone of the frontal sinus beginning apparently at its outer angle.

On May 15, 1927, three years and nine months after the operation, the patient was in excellent health. He had a firm depressed scar of the frontal sinus. He had been free from all symptoms, either nasal or general, and had been particularly free from colds. Examination of the nose showed no pus and a normal looking mucosa. The infection in the teeth had not recurred and no teeth had been extracted. Transillumination showed that the antrums were clear. Roentgen-ray examination of the sinuses did not show any diseased cavity.

COMMENT

The absence of all signs of an acute nasal infection and the nonexistence of any chronic nasal discharge caused considerable speculation as to the cause of the sudden attack of acute frontal osteomyelitis. The puncture of the antrum, made only because a routine examination showed darkness of the antrum on transillumination, showed some cloudy secretion with an odor, but this did not explain the serious condition of the patient. At operation the frontal sinus was empty, except at the beginning of the nasofrontal duct, in which there was a small collection of fibrinopurulent pus. This case did not present the usual picture of acute or chronic suppuration of the frontal sinus. This small amount of pus in the frontal end of the nasofrontal duct is sufficient to explain the acute osteomyelitis. My interpretation of the sequence of events is as follows: (1) infection of the antrum from a dental focus, (2) a spread of the infection to the nasofrontal duct and into the frontal sinus with a resulting (3) direct invasion by the organism (a staphylococcus) of the osseous spaces (canalicular and medullary) of the bony wall of the sinus (or a primary infection of the small efferent veins of the lining membrane of the sinus with rapid infection of the bone from the veins).

In my experience, the case was atypical.

THE TONSIL PROBLEM

WORKING HYPOTHESIS FOR GENERAL GUIDANCE

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It may seem that the tonsil problem is definitely settled and the large number of tonsils that are removed apparently bears out this thought; but in the minds of many, the problem is not solved. Under the circumstances it is often difficult to advise patients. Those patients are of all ages and come from all walks of life. Many have been given different types of advice, a good deal of which is based on prejudice rather than on scientific knowledge.

A physician's sister will tell you that her tonsils can be removed only over her brother's dead body. Other patients are advised that the mere fact that tonsils exist is excuse enough for letting them alone, unless a case against them can be definitely proved.

It would seem that a fair way of attempting to settle this problem would be to approach the question by giving due consideration to what is known to be the histology of the organ, and what one has every reason to assume is its physiologic activity.

A certain number of leukocytes (mostly lymphocytes) supported by a recticulum of fibrous tissue, the mass encapsulated by denser fibrous tissue, afferent and efferent vessels, together with the necessary nerve supply, constitute a lymph node. All lymph nodes, except the superficial inguinal lymph nodes, interrupt the continuity of lymph vessels and therefore are buried and beneath the deep fascia. Sections of a normal lymph node from one part of the body are not to be recognized histologically from those from other parts or from the so-called tonsil, except at its exposed surface. This fact demonstrates the closest possible relationship between lymph nodes and the faucial tonsil. Enlarged cervical nodes, so often present in chronic, or following acute, disease of the tonsils, makes plain a direct communication by way of lymph flow between these structures and the tonsil.

That the tonsil possesses a distinct capsule on its attached surface is plainly demonstrated on the enucleated tonsil, but demonstration that its exposed surface is covered by flattened nonciliated epithelium which dips into its crypts, a continuation of the mucosa of the pharynx, is not possible except in the fetus or perhaps during early life.

A study of enucleated tonsils shows that this epithelial covering is absent in practically 100 per cent of the cases, and that the tonsil crypts are obliterated, presenting, instead, encysted plugs of infected epithelial débris and venous thrombosis. It may be argued that its disappearance

is the direct result of the traumatism of enucleation, but it can be more reasonably explained through pressure from beneath, the result of the first or early inflammatory reaction. The presence of the large number of lymph cells known as salivary corpuscles, which are constantly present in the saliva, can be explained only by the absence of this epithelial layer. Moreover, the tonsil is of mesodermal origin, while the epithelium of the digestive tract is endodermal.

The phagocytic activity of the polymorphonuclear leukocyte has been definitely established by the work of Wright and others.

Murphy and his co-workers suggest a protective function for the lymphocyte, which, according to Macleod, is not definitely proved. However, the behavior of a chain of lymph nodes approximal to an area of localized infection and the frequency of acute infections of lymphatic structures when exposed to the air would tend to substantiate the existence of such a function. Few would deny an apparent definite relationship between the activity of the polymorphonuclear leukocyte and the lymph node in the mechanism of human defense against disease.

The activity of a lymph node must be similar in its purpose to the physiology of the white blood cell. The white blood cell appears to be distinctly offensive in character, or at least readily stirred to combat in event of a pathologic process, which results in an inflammatory reaction. In fact, the migration of the leukocytes into an area so involved is a part of the inflammatory reaction.

When the foregoing is considered, the presence of the lymph node which is spoken of as tonsil, stripped of a part of its capsule, with its parenchyma exposed in the pharynx and connected with the general lymphatic system, may well serve as an omnipresent and omnipotent avenue of infection for systemic disease. In this location one finds a lymph node struggling to be normal physiologically despite its altered anatomy. Practically, one finds here the white blood cell making an effort to function under aerobic conditions while constantly bombarded by all types of organisms.

Local or general conditions of ill health, from the standpoint of either infection or toxemia, may depend on the resistance of the tonsillar structure and of the peritonsillar tissue.

The plica triangularis, the triangular fold of membrane in the tonsils, which normally extends from the upper posterior portion of the anterior faucial pillar backward and downward until lost at the base of the tongue, and which sometimes contains muscle fibers, occasionally is much more extensive and is reflected backward and upward to cover the whole tonsil and to blend with the posterior pillar. Such a tonsil becomes a true lymph node in an anatomic and a physiologic sense. Such an organ will of necessity always be free from what is recognized

as tonsillar disease, as it can be reached by infection only through the general lymph stream. This type of "tonsil," so-called, leads one to believe that the faucial tonsil exists as a result of evolutionary changes.

That Nature at times seems to attempt to replace this lymph node when removed, is often given as an argument against tonsillectomy. It is doubtful that this takes place. It is probable that any tonsil thoroughly enucleated, that is, removed with what is spoken of as "its capsule" intact is ever replaced, regardless of what may appear to have regenerated in the fossa of the tonsil. That such a thing appears to happen, is true. Lymphoid tissue, which may not be differentiated histologically from true tonsil, is to be seen in many tonsillar fossae after the tonsil has been thoroughly enucleated. This can be explained in other ways than as regrowth of the tonsil, if the patient has been watched during the convalescent period after operation. Due to traumatic inflammatory reaction, lingual tonsillar tissue, perhaps not previously observed, will often half fill a pharyngeal tonsillar fossa in forty-eight hours, and during the two succeeding weeks a part of this tissue may become embedded in the scar.

The ideal tonsillectomy leaves a fossa lined with fascia. Lymph nodes exist in this fascia and, thus exposed, may hypertrophy and behave in a manner similar to that of included lingual tonsillar tissue. Occasionally a chain of lymph nodes, situated behind the posterior pillar, become affected with hyperplasia and often seem lost in the free border and anterior surface of the posterior pillar.

Such postoperative observations are not unusual, and they are not to be looked on as an objection on the part of Nature to tonsillectomy or a reflection on the character of the surgical procedure. They are simply the result of the reaction of the tissue to traumatism.

The thought to be borne in mind concerns the alteration of the venous and lymphatic drainage and the substitution of a firmer, more resistant fossa. In such, manifestly, the afferent flow of blood and lymph is reduced to a minimum, and the chances of absorption are reduced in proportion.

The tendency of a patient toward acute infection of the lymphatic structure is not altered by tonsillectomy. Infection of this migratory lymphatic tissue is most likely to occur when a patient would otherwise have an acute disease of the tonsil. It is my belief that throats from which the tonsils have been removed, including those in which this phenomenon of apparent tonsillar regeneration has taken place, are less frequently subject to acute attacks; that the duration of the disability and the severity of the symptom cause little if any concern, and that such patients seldom have either such complications as occur following acute disease of the tonsil or chronic toxemia; when such complications do occur, they can be more reasonably accounted for in some other way.

SUMMARY

Viewing the tonsil problem from the foregoing standpoints, the following conclusions may be drawn:

The tonsil is but a lymph node in the ordinary sense which has lost its identity through changes in development.

The tonsil is not a special organ with a special function.

There are no rational contraindications to the surgical removal of the faucial tonsil per se.

The faucial tonsil is not a part of the digestive system as is usually stated in textbooks of anatomy.

The average tonsil is not covered with epithelium as are all parts of passages and cavities which have a direct communication with the outer surface of the body.

It is fair to assume that because of the broken surface of its protective epithelium, its exposed position and the natural tendencies of its structure to attract microorganisms the faucial tonsil offers less resistance to the entrance of infection or the products thereof to any part reached by the circulating body fluids than any other point in the anatomy.

Evidence that a tonsil thoroughly removed ever grows is lacking.

The reappearance of lymphoid tissue in or about the tonsillar fossa is the result of reaction of the tissue to traumatism.

Although such tissue is naturally prone to acute infection, the tendency toward transmissions to remote parts is materially lessened because of resistance offered by the formation of scar tissue.

It is highly improbable that toxemia results from chronic infection of such tissue.

Clinical Notes

SARCOMA OF THE MASTOID

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In reviewing the literature, one is surprised at the limited number of authentic cases of malignant disease that are reported. This may be due either to the lack of recognition of a malignant condition or to the fact that because of its grave prognosis, attention is not called to it. Foreign contemporaries have been more diligent in giving data on these cases. In an exhaustive study, Zeroni[1] was able to collect reports of 121 cases of malignant conditions of the ear which had been published during the previous ninety-five years.

Milligan[2] furnished further data in the records of the London Hospital, in which the average attendance of patients a year is 200,000. During a ten year period, not a case was reported.

Lévêque[3] said that Dupou estimated that in one of every 10,000 cases of chronic otitis media, malignant disease developed. There can be no doubt that chronic irritation (i. e., discharge) is a prominent factor, but Schwartze[4] thought that malignant disease usually attacks a healthy ear. Neuhart[5] was able to collect reports of thirty-four cases of malignant disease of the middle ear from 1899 to 1916. Only eight of these cases were reported in the United States.

The possibility of overlooking this condition was shown by Kretschmann,[6] who reported sixteen cases. Diagnosis was not made in five until operation. Schwartze noted six cases, but diagnosis was made in only three before operative intervention.

Sarcoma is mentioned less frequently than carcinoma, which no doubt is due to the fact that it is of rarer occurrence. Brose[7] reported a case in a child, aged 3½, which followed a clinical course similar to that in the case reported in this paper. Christinnick[8] reported two cases; Haug[9] described one case, that of a patient, aged 18, whose ear had been discharging since he was 3 years of age. Kipp[10] reported a case in a child, aged 5, in whom a mass was present in the canal for a few months. The child died six months after operation. The condition was diagnosed as small round cell sarcoma. Early diagnosis and complete exenteration of the mastoid cells prevented recurrence

1. Zeroni: Arch. Ohrenh., 1899, p. 141.
2. Milligan: Proc. Roy. Soc. Med., 1907-1908.
3. Lévêque: Gaz. méd. de Nantes, 1910, p. 89.
4. Citing Burton: Laryngoscope **27**:755 (Oct.) 1917.
5. Neuhart, H.: Laryngoscope **27**:543 (Dec.) 1916.
6. Kretschmann: Arch. Ohrenh., 1886, p. 231.
7. Brose: Arch Otol. 1898, vol. 27.
8. Christinnick: Arch. Ohrenh., vol. 18, p. 291.
9. Haug: Arch. Ohrenh., vol. 30, p. 126.
10. Kipp: Trans. Am. Otol. Soc., vol. 8, p. 63.

in a case reported by Tobbey[11] in which operation had been performed thirteen years previously. Friedenwald and Kelmer reported an interesting case in which an early diagnosis gave them the opportunity to intervene: two years later, there had not been a recurrence. The foregoing exceptions are the ones under which recovery can take place. The apparent difficulty in recognizing these conditions is that physicians many times fail to attach enough significance to the seemingly benign mass which later develops into a malignant condition. All polyps removed from the ears of adult patients are worthy of pathologic examination.

Pain is usually the first symptom and may be felt behind the auricle or may be referred to the meatus. Swelling and tenderness over the mastoid, facial paralysis, loss of hearing and labyrinthine symptoms occur in proportion to the degree of involvement, and cachexia is present. A metastasis is unusual. Sarcoma runs a rapid course in from six months to one year. The prognosis is always grave; unless operation is performed the condition is hopeless, but early operation gives a better prognosis. Radium and deep roentgen-ray therapy may be of assistance as adjuncts to the operative procedure.

REPORT OF A CASE

History.—H. F., a colored man, aged 32, complained of discharge and pain in the right ear following radical mastoidectomy. His father and mother, two brothers and one sister were living and in good health. The history was negative as to tuberculosis and malignant disease. The patient had had scarlet fever at the age of 2. The right ear had discharged at intervals since that time. He had had typhoid at the age of 20. He said that he had had venereal infection. Eight months before admission to the hospital, the right ear felt full, and pain and dizziness were present. He consulted a confrère in the city, who removed a large polypoid mass. The symptoms were relieved. The patient returned in six weeks, at which time the pain and mass were again present. Radical mastoidectomy was performed in a neighboring city. The patient came under my observation two months later, referred by the same confrère, who said that the patient now had a facial paralysis, and also that the radical cavity was filled with granulation tissue. He complained of intense boring pain in the head, which was worse at night.

Physical Examination.—The patient weighed about 150 pounds (68 Kg.). He appeared restless and worn by pain. Facial paralysis had been noticeable the day after the radical mastoidectomy had been performed. The cavity was filled with granular tissue. Neither swelling nor tenderness, either posteriorly or on the tip were present, and there was no glandular involvement.

The Wassermann reaction with the spinal fluid was 4 plus. The results of the test of hearing and the vestibular test are given in tables 1 and 2.

Under ether anesthesia the right posterior wound was opened, and the granulation mass was curetted thoroughly from the cavity, which was completely filled with this tissue. Hemorrhage was insignificant and was easily controlled. The posterior wall was reduced and the cavity markedly enlarged. A fistula was present in the horizontal canal, and the meatal opening was enlarged to facilitate postoperative dressings. The radical cavity was tightly packed with the usual narrow packing. The pressure pain was relieved after this operation. Ten days later, a skin graft was applied to the cavity. This did not adhere. One week later, I noticed a return of the vascularized granula-

11. Tobbey: Boston M. & S. J. **165**:726, 1911.

tion mass in the hypotympanum. The general condition of the patient was not as good as it was two weeks previously. The mass increased so that four weeks after the operation the cavity was half filled with the tissue. Again the posterior incision was laid open, all the granular tissue was removed and a specimen sent to the laboratory for examination. The laboratory reported in a few days that small round cell sarcoma had been found. Radium was used but did not appear to influence the mass. The patient began to lose weight and appetite rapidly and complained of intense boring pain in his head. He showed the usual physical signs of the ravages of the underlying malignant condition. Morphine was given at pleasure.

TABLE 1.—*Results of Test of Hearing*

Right		Left
Negative	Watch	40 inches
Negative	Whisper	30 feet
Negative	Lower tone limit	26 double vibrations
Negative	Upper tone limit	2048 double vibrations
Negative	Weber	Present
Negative	Rinne	Positive

TABLE 2.—*Results of Vestibular Test Turning*

To right		
Amplitude, good.		
Duration, 45 seconds		
	Nystagmus	Present
	Vertigo	Present
	Past pointing, 3 to right	
To left		
Amplitude, small		
Duration, 10 seconds		
	Nystagmus	Slight
	Vertigo	No
	Past pointing, negative	

After the last removal of the granular mass, it recurred with great rapidity. There can be no doubt that these operations were the direct means of adding to the malignant condition. Ten days after the last removal, the cavity was completely filled. About this time, it was noticed that the mass was forcing itself into the adjoining subcutaneous tissue, finally breaking through the posterior incision. It had also invaded the tissues in front of the ear. The large swelling posteriorly had displaced the auricle anteriorly. One month later, at the time of death, this mass protruded through the incision and was 4 inches (1.8 cm.) in diameter. Permission for autopsy could not be obtained.

CONCLUSIONS

With the knowledge I now have of this case, it is reasonable to surmise that if the original polypoid mass had been examined microscopically; if early surgical intervention by means of radical mastoidectomy with complete exenteration of all the mastoid cells had been made use of, and if radium and deep roentgen-ray therapy had been employed, more could have been offered as to prognosis than was possible when the patient came under observation.

TWO INSTRUMENTS FOR THE RESECTION OF ANTRUM WINDOWS

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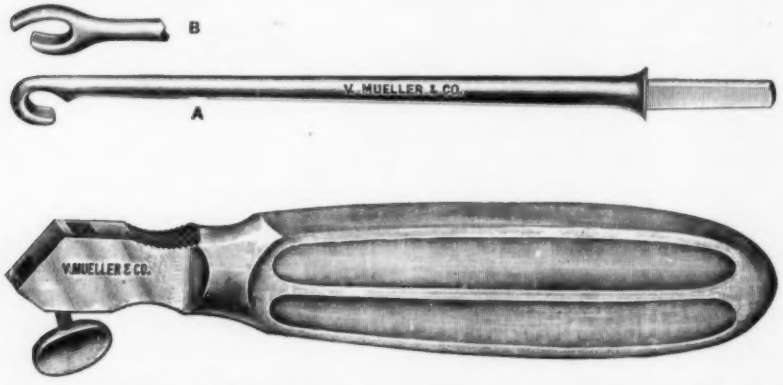
I have found the two instruments illustrated in the sketch practical and useful in resection of the antrum window. They can be used in either the simple or the radical types and are especially adapted to breaking down thick naso-antral walls.

The anterior bone resector has proved indispensible, as it easily and rapidly breaks down the naso-antral bony wall in a forward direction. This is accom-



Instrument for resecting the antrum window *A*, anterior bone resector; *B*, posterior bone resector.

plished by perforating the naso-antral wall posteriorly with a Wellamenski's antrum perforator, or other suitable instrument, and engaging the bone in the embrasure of the bone resector. By a twisting and rotary motion of the handle, the wall is readily broken down in a forward direction.

The posterior bone resector is not so useful but may be helpful when working space is limited. At Dr. C. Armin Gundelach's suggestion, I have lengthened one lip of the instrument to facilitate engaging the bone in the embrasure.

These instruments are fitted to the Sluder handle and can be used in operations of either a right or a left antrum. It is evident that they require little operative space, and also that there is enough leverage in their use to break down a resistant naso-antral wall.

Progress in Otolaryngology

A Summary of Bibliographic Material Available in the Field of Otolaryngology

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TUBERCULOSIS OF THE UPPER RESPIRATORY TRACT

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ETIOLOGY

There has been considerable dispute as to the pathways of infection in laryngeal tuberculosis, although a monograph written by Blake about twenty years ago demonstrated clearly that at least the large majority of the laryngeal involvements took place through the mucous membrane, usually by way of small nonspecific pathologic lesions in the epithelium. The contention of several well known authors that the invasion is lymphatic has never seemed warranted to me.

Esche [1] believed that the infection of the larynx usually comes from the bacillus laden sputum coughed up from the lungs and brought into intimate contact with the mucous membrane of the larynx and that the bacilli gain access to the subepithelial tissues through minute trauma produced by coughing. He also believed that it is possible for the tubercle bacilli to penetrate through certain portions of the normal epithelium of the larynx just as they have been proved to penetrate through the mucosa of the intestine. He admitted that this theory of mechanical trauma with inoculation from the sputum does not satisfactorily explain the development of laryngeal disease in patients who do not have bacilli in the sputum. His view is that in these cases a latent infection of the larynx has developed into active disease when later, for some reason, the local resistance becomes decreased. His reasons for disbelief in the lymphatic theory of laryngeal infection are: first, that there is practically no lymphatic connection between the tonsils or cervical lymph nodes and the larynx; second, that experimental injections of bacillary emulsions into the tonsillar lymph nodes and skin at the angle of the jaw have never caused disease of the larynx; third, that in human pathologic processes extensive tuberculosis of the lymph glands of the neck has never been followed by disease of the larynx, and lastly, that laryngeal tuberculosis

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1. Esche, A.: Was Wissen Wir Ueber Die Entstehung und Den Beginn Der Kehlkopftuberkulose, Klin. Wchnschr. **5**:1882, 1926.

in children is extremely rare, though involvement of the tonsils and lymph nodes of the neck is common. As far as a hematogenous pathway is concerned, this is theoretically possible in miliary tuberculosis.

Giercke's [2] results from his study concerning the relation of laryngeal tuberculosis to pulmonary disease substantiated Esche's statements. Giercke found that 28.3 per cent of 679 patients that he had observed in the past two years showed either positive tuberculosis of the larynx or suspicious lesions. In an examination of 872 patients with pulmonary tuberculosis, Parfitt [3] found the larynx involved in 16.4 per cent. Giercke found further that the frequency of secondary laryngeal tuberculosis depends largely on the virulence of the infectious material coughed out of the lung and that there is a distinct parallel between the severity of the disease of the lung and the severity of the complicating laryngeal infection. When there is a distinct difference between the severity of the lesion of the lungs and that of the larynx, the ultimate prognosis hangs on the severity of the involvement of the lungs. Because permanent improvement as a result of local treatment in laryngeal tuberculosis can be expected only when there is also improvement in pulmonary disease, Giercke believed that with an advanced and hopeless lesion of the lungs, only symptomatic treatment of the larynx should be considered.

While Giercke is probably right as far as the ultimate prognosis of life is concerned, in that it usually depends on the pulmonary condition, it is also true that appropriate local treatment will often arrest and apparently cure the laryngeal involvement even while the condition of the lungs is growing worse. Also occasionally one sees a patient in whom the laryngeal lesion is so predominating and so severe that one must regard it as the responsible agent in the patient's death.

PATHOLOGY

For some time, the general conception of the pathologic picture of laryngeal tuberculosis was that it did not have any particular specific peculiarities and that the disease in the larynx would show histologic evidence of tuberculosis similar to that in other portions of the body. Manassa [4] described in the utmost detail both the gross and the histologic appearances of tuberculosis of the upper respiratory tract and added much to the knowledge of the tuberculous changes that are peculiar to the larynx. Any one interested in the subject would do well to read it in the original.

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2. Giercke: Ueber Beziehungen Zwischen Lungen und Kehlkopftuberkulosen, Beitr. z. Klin. d. Tuberk. **62**:436, 1926.

3. Parfitt, C. D.: Edinburgh M. J. **3**:181 (March) 1927.

4. Manassa: Pathologische Anatomie der Tuberkulose der oberen Luftweg. Ztschr. f. Hals,-Nasen- u. Ohrenh. **15**:1, 1926.

In his description of tuberculosis of the upper respiratory tract, Manassa adopted Aschoff's classification; first, infiltration, with or without edema, including miliary tubercules on the surface; second, ulceration; third, perichondritis, and fourth, tuberculoma or formation of tumors.

Infiltration.—Macroscopically, the infiltration appears as a more or less generalized thickening and may occur in any portion of the larynx. When the vocal cords are involved they become thickened and on cross-section appear round instead of the normal three cornered shape. The epiglottis may be generally or locally enlarged, losing its shell-like form but remaining smooth in outline. The infiltrations are usually redder than the surrounding mucosa; sometimes they are an intense red but occasionally they are a light pale rose. The surface of the infiltration is usually smooth, even when it is studded with miliary tubercles. On a histologic examination of the infiltrated area the epithelial covering is always intact whether it is of the squamous or cylindric type. The epithelium may become much thickened, producing pachydermia. The characteristic changes, however, are found in the subepithelial connective tissue. Here one sees round cell infiltration, typical tubercles and, perhaps, edema. Sometimes the tubercles are solitary, unaccompanied by other changes in the tissues, or several of them may be close together, showing a tendency to confluence. This picture must be accepted as the earliest stage of laryngeal tuberculosis. In this early stage the tubercles are immediately under the epithelium, and even when the whole layer of connective tissue is involved, they are found in increased numbers near the epithelium; this subepithelial tissue may, at times, be practically obliterated with tubercles, while there are none near the perichondrium. In this tissue around the mucous glands and sometimes in the blood vessels, isolated giant cells occasionally are found unaccompanied either by round-cell infiltration, epithelioid cells or cheesy degeneration. Sometimes the round-cell infiltration is so marked that the tissue appears more like an area of simple infiltration, except that typical giant cells may be seen scattered through it.

Edema.—Edema, which is apparent to the naked eye, occurs in two types—one in which large spaces are present in the connective tissue, some of them being lined with endothelial cells and usually crossed with fine connecting fibers. The cellular contents of these spaces resemble somewhat those found in the polypoid changes of the nasal mucosa. In the other type, there are numerous microscopic spaces between the bundles of connective tissue; they are irregular in size and contain cellular elements similar to those found in the large spaces of type 1. The separating bundles of connective tissue usually run parallel and can be traced for quite a distance. Manassa believed that these spaces in the

connective tissue are dilated lymph spaces or perhaps large lymph vessels which have become dilated and confluent. Tubercles are not found immediately near this edematous tissue, which often does not show any inflammatory reaction, though occasionally a simple infiltration of lymphocytes is present.

Edema does occur that is not recognizable as such by the naked eye, and differs essentially from the foregoing description. For instance, in the subepithelial infiltrations of the epiglottis, in the area between the tuberculous infiltration and the perichondrium, there appears to be a slight but regular and distinct separation of the fibers of connective tissue. This forms a fine meshed net, and only an occasional free cell can be seen in the meshes. The fibers themselves do not show evidence of degeneration and possess nuclei that stain well. One must therefore recognize two kinds of edema, both of which are interstitial and probably the result of stasis produced by pressure from the increase in the thickness of the structures. Less frequently, a true parenchymatous edema is seen distinct from the interstitial types described. In this, the individual cells of connective tissue are swollen, with pale protoplasm and without vacuoles; the nuclei are small, stain poorly and are sometimes absent so that the cell appears as a clump of hyaline tissue. These edematous cells are usually found in or near ulcerated areas. The fibers of connective tissue may also be swollen.

Ulceration.—It was formerly supposed that tuberculous ulceration was due to caseous degeneration of one or more tubercles immediately beneath the epithelium. Careful microscopic study, however, of small ulcers shows that the process at least starts without any caseation of the underlying tubercles. Minute microscopic ulcers are frequently found in an otherwise intact epithelium, and in the tissue beneath these ulcers evidence of caseous degeneration is never seen. The edges of the epithelium around the ulcer show degenerative processes, and the defect in the epithelium is filled with tuberculous granulation tissue consisting of lymphocytes, epithelioid cells and giant cells. Islands of epithelial cells may be found in this granulation tissue, sometimes with evidence of degeneration. There is therefore no question that the early ulceration of mucous membrane is not due to a rupture of caseous tubercles beneath the epithelium, but rather to an active extension of intact tuberculous granulation tissue which partly destroys the epithelium and partly encloses it. Sometimes one sees an even earlier stage in which the basal portion of the comparatively normal epithelium is infiltrated with cells from the underlying infiltration. This condition could be designated as a preulcer stage, and it shows that the breaking down of the epithelium is due to an infiltration beginning in the basal cells. The epithelium itself reacts to this process, and in the region of these ulcerations the basal cells of the epithelium grow into the deeper structures. The

sprouts of epithelium which penetrate into the granulation tissue communicate by fine or thick extensions and so form a net, the meshes of which are filled with granulation tissue. These epithelial sprouts may be cut off by the granulation tissue and isolated, and they then may become degenerated and destroyed. This struggle for supremacy between the epithelial and connective tissue elements usually results in the destruction of the epithelial cells. However, the connective tissue elements later on are destroyed by the tuberculous toxin and in large ulcers the central area shows a vast degenerative process with caseation, though the edges of these ulcers show a picture similar to those found in the small ulcer. When the surface epithelium is of the cylindric type, one finds a similar destruction of the epithelium by the underlying tuberculous tissue, but there is an absence of a regenerative process such as is seen when the squamous epithelium is attacked. Sometimes the cylindric epithelium around both small and large ulcers undergoes a metaplasia with a change of type to squamous epithelium. When this takes place, the newly formed squamous epithelium acts in a way similar to that of the normally placed squamous cells.

In tuberculous persons extensive ulceration is almost always due to tuberculosis, but a nonspecific ulceration may occur and, further, may closely resemble tuberculosis. Manassa reported one such case. A unilateral typical involvement of one vocal cord was present. The pathologic examination showed round cell infiltration of the cord and a deep ulcer on the posterior wall, with a pachydermia of the covering epithelium but without any evidence of tuberculosis anywhere in the larynx. Although tuberculous ulceration is usually accompanied by extensive destruction of the superficial structures, a deep widespread involvement of the underlying tissues with a small superficial defect may be present.

Perichondritis.—When perichondritis is present, there is usually a complete destruction of the superficial structures by ulceration, though occasionally the perichondrium becomes involved while the overlying tissue is still intact. It is interesting to note that the perichondrium may show an advanced tuberculous disease while it is still attached to the cartilage, but even at this time the cartilage may show degenerative changes, which of course become more marked when the perichondrium is completely destroyed. Occasionally, advanced necrosis of the cartilage may take place while the perichondrium is still attached, though this is not a usual occurrence. If the cartilage has become ossified, a typical tuberculous osteomyelitis may develop, destroying all the bone tissue. On the other hand, while a tuberculous perichondritis may destroy the cartilage by producing extensive necrosis with the formation of sequestrums or by destruction of small isolated portions of the cartilage without distinct formation of sequestrums, Manassa did not report true tuberculosis of the cartilage itself.

Formation of Tumors.—It is necessary to recognize two types of tumors, one a true tuberculoma and the other, pachydermia. While tuberculoma is a true product of the tuberculous disease, the formation of the tumor may be so extensive that it is sometimes confused with malignant neoplasm. These tuberculomas may be round or oval in shape, with a broad sessile attachment or a short stem; they are reddish and usually have a smooth surface, though occasionally they are corrugated and almost never ulcerated. The border is generally sharply outlined, though occasionally it is not well demarked; hence, it may be difficult to class the lesion either as a tumor or as a simple infiltration. There are two types, the fibrotuberculoma which shows typical tubercules but which had a preponderating connective tissue element and granulotuberculoma, in which the tubercles are surrounded by granulation tissue. The fibrotuberculomas are usually pedunculated and can easily be removed with the snare. There is present the predominating connective tissue with typical giant cells, but seldom any caseation. The granulotuberculomas are seldom pedunculated, and the connective tissue is replaced by granulation tissue. The typical tubercles and giant cells are present, but here also caseation is not often seen. Manassa reported one case, however, in which the larynx had been removed on the supposition of malignant disease, and in which he found a tuberculoma of the vocal cord consisting of granulation tissue and tubercles, which were in large part caseated.

Pachydermia.—Pachydermia is found only when squamous epithelium is present normally or as a result of metaplasia. These tumors are characterized by papillomatous hypertrophy of the squamous epithelial cells, sometimes to an unbelievable extent. While this thickening of the epithelium may occur in simple chronic laryngitis, the tumor formation is a great deal more marked in tuberculosis. This thickening of the epithelium is usually associated with simple infiltration, though a neighboring ulcerative process may be present. Microscopically, pachydermia resembles papilloma, but typical tuberculosis is found in the underlying connective tissue; it is usually deeply placed but sometimes is present just beneath the epithelium, and it may be found in a larynx which does not show other evidence of tuberculosis. Hence, a marked thickening of the posterior commissure must always be looked on with suspicion.

Striated muscle fibers may undergo a simple degeneration even in places fairly well removed from the tuberculous areas. This degeneration is not a true tuberculous process and is probably caused by the absorption of toxins produced by pyogenic bacteria or from the breaking down of tuberculous tissues.

Chondritis.—Severe involvement of the cartilage, with necrosis and sequestration as a result of tuberculous invasion of the perichondrium,

has already been described. Besides these necrotic changes, the cartilage sometimes shows a secondary alteration in which there is apparently a pure inflammatory process without necrosis. This is evidenced by the penetration of round cells into the cartilagenous tissue; these cells later change into connective tissue. In this manner, without any great change in form and shape, large portions of the cartilage can be replaced by blocks of connective tissue. In this connective tissue small remnants of cartilagenous substance are frequently seen and, what is remarkable, small inserts of epithelium are sometimes found; however, the latter occurs only when the contiguous epithelium exhibits a high grade pachydermia.

From his pathologic study, Manassa believed that undoubtedly these tuberculous lesions may become completely healed without any macroscopic evidence of tuberculosis but that if histologic examinations were made in such cases, one would find some areas of tubercles and giant cells and perhaps even caseation.

SYMPTOMATOLOGY

The occurrence of paralysis of the recurrent laryngeal nerve in pulmonary tuberculosis, though uncommon, has probably been noted by the majority of specialists and supposedly is due to the nerve's being pressed on by enlarged bronchial lymph nodes. Arnstein [5] reported five cases in all of which only the left nerve was paralyzed, though in two paralysis of the left phrenic nerve was also present. His explanation of the frequency of the left nerve only being involved was an anatomic one based on the fact that on the left side the recurrent nerve comes in close contact with the tracheobronchial glands but that on the right side it turns back at a higher point and does not reach this group of glands. The diagnosis of injury to the phrenic nerve was confirmed in one case by a roentgenogram, which showed a marked elevation of the left side of the diaphragm. In the second case in which the phrenic nerve was involved, and which came to autopsy, the left recurrent nerve was found involved in a large gland near its origin from the vagus, and the nerve below its exit from this gland showed degenerative changes. The phrenic nerve was also caught in this gland and showed the same degeneration. On the right, the recurrent nerve was in apposition to enlarged lymph nodes but was not enclosed by them and did not show degeneration. The interesting feature of this postmortem examination was that the paralysis of the nerve was due not so much to pressure as to actual destruction by the tuberculous process. It would further appear from the foregoing autopsy that the cervical lymph nodes as well as the tracheobronchial nodes may be responsible for a recurrent paralysis.

5. Arnstein, Alfred: Wein. Klin. Wchnschr. **39**:1191 (Oct. 7) 1926.

TREATMENT

For some time I have felt that radical attempts, such as tonsillectomy, to remove focal infections in tuberculous persons were usually followed by diastrous results and that the chances for harm were greater than the possibility of good. Baker [6] called attention to the dangers of wholesale extraction of teeth in tuberculous persons. He said that if extraction of a number of teeth is necessary it should be done with the utmost caution, and only one or two teeth should be removed at a time, the indications for future work being judged by the response of the individual patient to the first operative procedure. He felt that the loss of blood following these operations is an important item in the influence it has on the patient's health and that for this reason a study of the ionic calcium content of the blood should be made in every case and, if necessary, calcium lactate should be administered. According to Baker, the calcium lactate not only tends to reduce postoperative bleeding but also aids in the quick repair of the tissues.

Nuhsman [7] said that the use of "Sanocrysin" in tuberculosis is not contraindicated by the presence of a laryngeal involvement. He reported one case that showed an extensive progressive laryngeal tuberculosis and only slight involvement of the lungs. This patient received six injections of "Sanocrysin." Immediately after the first injection the disease in the larynx stopped spreading, and within ten days the dysphagia had disappeared. The objective symptoms, ulceration and edema of the arytenoid, also disappeared and the voice became clear. While Nuhsman felt that laryngologists should themselves consider this form of therapy, he said that there still remains a good deal of work to be done as to the type of case in which this treatment should be employed and also the dose and method of its use.

Heliotherapy.—Heliotherapy is probably being used more and more every day, not only as a general tonic to the whole body but also locally, the direct rays of the sun by reflection or by means of the water cooled quartz lamp being employed. Van Horn [8] believed that heliotherapy is an important adjunct in the treatment of laryngeal tuberculosis. In fact, he said that it is the treatment of choice and that the reason for so many unfavorable reports is that the technic is faulty and also that patients are entrusted with the treatment themselves. He said that it is practically impossible for a patient himself to succeed in get-

6. Baker, D. T.: Removal of Focal Infection in Treatment of Tuberculous Patients, U. S. Vet. Bur. M. Bull. **3**:149 (Feb.) 1927.

7. Nuhsman: Ist Kehlkopftuberkulose Eine Kontraindikation gegen Sanocrysinbehandlung, Arch. f. Ohren,- Nasen- u. Kehlkopfh. **116**:83 (Dec.) 1926.

8. Van Horn, Homer: Some Observations upon the Treatment of Laryngeal Tuberculosis, U. S. Vet. Bur. M. Bull. **2**:1027, 1926.

ting the sun rays properly reflected into the larynx. The irradiation should be done by experienced operators who use metal mirrors, and the treatment must be carried out in the open air without the intervention of glass. If this is done, the sun's rays are far superior to those of the water cooled quartz lamp. It is also important that the dose should be most carefully supervised, the amount varying from day to day according to the reaction seen after the previous treatment. Overdosage must be carefully guarded against. It is also to be remembered that the intensity of the sun varies almost every day so that while sometimes four minutes exposure may be given with immunity on another day two minutes exposure could not be tolerated. As a rule the daily treatments start with a dosage of about thirty seconds which may be increased up to ten or even more minutes if there is no evidence of overreaction, but some treatments can never be carried beyond two minutes.

Blumenfeld [9] was not so enthusiastic as to the value of radiation either by sunlight or by artificial light. He admitted, however, that the local radiation has a distinct effect in the lessening of pain and that this, of course, is an important phase of therapy in laryngeal and pharyngeal tuberculosis.

For those who are especially interested in heliotherapy in its relation to laryngeal tuberculosis, Minnigerode's [10] article contained a vast amount of information on the whole subject. The little new data that have been added to the literature are more an elaboration of what has been done in recent years. In his conclusions, Minnigerode stated that the use of the roentgen rays in laryngeal tuberculosis will produce favorable local and general results in the hands of experienced physicians but that it requires an accurate estimate of the indications with a strict and complete control of the technic. If an accurate technic is followed beneficial results can be obtained, but the indiscriminate use of the roentgen ray in these cases is not justifiable. He classed it as one of the accessory aids to healing.

In regard to the use of the roentgen ray in laryngeal conditions, it is to be noted that a number of articles have recently appeared concerning the possibility of serious reactional phenomena. Iglauer [11] reported a case in which ulceration of the larynx occurred four months after roentgen-ray treatment. He collected from the literature a number of reports of cases and believed that while excessive or accumulative dosage of roentgen rays is probably responsible for most of the disastrous results, this does not appear to have been so in all cases.

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9. Blumenfeld: Klinik der Tuberkulosen der oberen Luftwege, Ztschr. f. Hals,-Nasen- u. Ohrenh. **15**:56, 1926.

10. Minnigerode: Die Physikalischen Behandlungsmethoden der Kehlkopftuberkulose, Zentralbl. f. Hals,-Nasen- u. Ohrenh. **9**:577, 1926-1927.

11. Iglauer, Samuel: X-Ray Injury to the Larynx, with Report of Case, Ann. Otol. Rhin. & Laryng. **36**:124 (March) 1927.

Gussol [12] called attention to the possibility of injury to the larynx by the roentgen ray and especially of the reaction following operations after roentgen-ray treatment. In two cases in which roentgen-ray treatment had been previously employed, in one of which radium was used also, marked edema suddenly developed, in one following the removal of a papilloma and in the other following simple pressure of a spatula in direct laryngoscopy. Gussol felt that even the introduction of an endoscopic tube should be avoided whenever possible, but that if such a procedure is necessary one must always bear in mind the possibility of rapidly occurring edema and be ready to perform a tracheotomy.

The most accurate study of the post roentgen-ray lesions of the larynx was that of Halberstaedter and Vogel.[13] The patients under their own observation were not those who had severe reactions, and at least two years had elapsed since the last roentgen-ray treatment. Of seventeen patients examined, five showed evident chronic laryngeal lesions. The authors believed, however, that these persistent lesions are uncommon. The most frequent condition was a simple dilatation of the blood vessels in an otherwise normal mucous membrane, resembling closely the changes seen in the skin at times. In the patients observed, the laryngeal lesions showed simultaneous marked changes in the skin caused by the roentgen ray, and most of them presented a more or less atrophic condition of the overlying soft tissues.

Undoubtedly, rest is an important therapeusis in the treatment of patients who have laryngeal tuberculosis. For this reason the immobilization of the larynx in these cases is interesting, as suggested by Schugt.[14] He drew attention to the method of sectioning the recurrent laryngeal nerve on one side as suggested by Leichsenring and Vonder Huton, but felt that the severity of this operation seldom justified its procedure. He accomplished the same result, that is, a unilateral paralysis of the larynx, by blocking the recurrent laryngeal nerve. His technic is as follows: A needle, from 6 to 8 cm. long, is carried through the soft tissues along the side of the first tracheal ring and pushed through to the vertebral column. It is then withdrawn from 1 to 1.5 cm., and from 1 to 1.5 cc. of 80 per cent alcohol is injected. The paralysis produced by this blocking of the nerve lasts about eight weeks, at the end of which time the muscles of the larynx resume their function to a greater or less extent. Schugt has not had any complications in his cases and has used this treatment in fifteen patients, claiming improvement in thirteen. Of course the patients must be selected, and only one

12. Gussol, Verner: Beobachtungen Zur Frage der Strahlenschadigung, Arch. f. Ohren,-Nasen- u. Kehlkopfh. **116**:89, 1926.

13. Halberstaedter, L., and Vogel, K.: Acta Radiol. **8**:81, 1927.

14. Schugt, Henry: Injection of the Recurrent Laryngeal Nerve in Tuberculosis of the Larynx, Laryngoscope **36**:756 (Dec.) 1926.

side of the larynx can be injected at one time. In those cases in which the aryepiglottic folds and the arytenoid cartilages were involved, he believed that the simple injection of the nerve is not enough to produce the required immobilization but that it should be followed by gastrostomy in order to eliminate the necessity of swallowing food.

Thompson and Trail [15] made some interesting observations on the effect of pneumothorax on laryngeal lesions. They quoted Dworetzky [16] as saying: "I have never observed laryngeal tuberculosis develop in the course of treatment (artificial pneumothorax) nor did I ever see this complication developing post hoc in cases cured or arrested by means of artificial pneumothorax." Thompson and Trail said in their conclusions that in cases of pulmonary tuberculosis the outcome is always rendered more serious by the addition of the laryngeal extension; that the laryngeal complication is of still worse augury if it develops after the patient is admitted to a sanatorium or after induction of artificial pneumothorax; that in spite of these experiences the presence of tuberculosis of the larynx is not a contraindication to this operation but that, on the contrary, it may speedily effect a cure or render more promising the addition of the galvanocautery or other treatment; that the condition of the larynx can be cured by this measure even though bacilli may continue to be present in the sputum and the lesion still remain in the chest.

My own experience with the foregoing local measures for the treatment of laryngeal tuberculosis has been limited because I am convinced that the use of the galvanocautery causes such rapid and marked improvement that I cannot feel justified in adopting the slower and less reliable methods. Heliotherapy, of course, can be advantageously associated with the treatment with the cautery, and in some advanced forms such operations as gastrostomy or perhaps the injection of the superior laryngeal nerve or even the recurrent nerve may be advisably considered.

Parfitt [17] said that in his experience the galvanocautery has largely displaced all operative measures except epiglottidectomy, and that when it is combined with rest of the voice it has been possible to dispense almost entirely with other time-consuming measures. He believed, however, that patients with laryngeal tuberculosis should be treated in a sanatorium provided that the sanatorium can furnish proper local treatment and especially that it have on its staff a physician trained in the use of the cautery. He found that in about 20 per cent of his cases the use of the cautery was the appropriate treatment and of these, cures were obtained

15. Thompson, S., and Trail, R. R.: Tuberculosis of the Larynx and Artificial Pneumothorax, Lancet **1**:963 (May 7) 1927.

16. Dworetzky, Julius P.: Ann. Otol. Rhin. Laryng., footnote 3.

17. Parfitt, Charles D.: The Treatment of Laryngeal Tuberculosis in Sanatoria, Am. Rev. Tuberc. **15**:579 (May) 1927.

in about 60 per cent. He comes to the conclusion: "That a conservative estimate would give approximately 25,000 patients in this country with laryngeal tuberculosis for whom the galvanocautery is needed and that more than one half of these 25,000 should obtain an arrested laryngeal lesion by its use."

Thompson [15] said that of seventy-four selected patients forty-six were cured by the galvanocautery, that is, 62.1 per cent. It is interesting to note that Thompson admitted that of 477 patients having laryngeal tuberculosis only 141 received local treatment. What of the remaining 336? I believe that any patient in whom the disease is still limited to the interior of the larynx may be benefited by appropriate local treatment, that is, cauterization. Even in those hopeless cases in which the disease has spread from the larynx on to the surrounding pharyngeal wall, cauterization frequently alleviates the distress, though I admit freely that I have never seen recovery occur in one of the latter cases.

Abstracts from Current Literature

Nose

A New Oculoendocranial Syndrome of Nasal Origin. P. Caliceti, Rev. Oto-Neuro-Oftalmologica **4**:419 (July-Aug.) 1927.

Caliceti reports a case of paralysis of the abducens with hemicephalia secondary to a nasal lesion. He says that so far as he knows no cases of paralysis of the abducens of nasal origin have been described. He mentions the observations of Missorici, who found paralysis of the abducens in four patients with malignant tumor of the nasopharynx, but in these patients the paralysis was due to the extension of the tumor to the apex of the petrous bone.

Caliceti's patient had had frequent attacks of sinusitis with respiratory difficulty, and finally, after an acute attack, the left side of the nose was closed completely, causing headache and diplopia.

Examination showed paralysis of the left external rectus without any other involvement of the eye. General examination gave negative results. Later, a rhinoscopic examination showed a polypoid hypertrophy of the head of the middle turbinate with the polypoid mass extending backward so as to occlude completely the inferior meatus.

Roentgen-ray examination showed slight opacity of the left sphenoid. Neurologic examination gave negative results. A few weeks later the author removed the polypoid mass, and two days after the operation a slight motility of the left eye was present, the motility being complete in the course of six days. The headaches decreased, and the nasal respiration became completely free. Fifteen days after the operation, the headache was not present, and the ocular motility was normal.

In discussing this case, the author says that it is impossible not to admit a close correlation between headaches and paralysis of the abducens and the polypoid nasal stenosis. In explanation of this case, certain hypotheses must be considered; either the hypothesis of Citelli, who says that there is a relation between the pharyngeal tonsil and pharyngeal hypophysis and from there to the central hypophysis, or the hypothesis of Poppi, who says that there is a decongestion and interrupted vascular relation between the nasopharynx and the endocranial cavity.

In experiments on dogs, Bronzoni presented the hypothesis that there was an anatomic relation between the erectlike bodies of the nasal mucosa and the lymphatic sheaths of the olfactory nerves.

By means of anatomic studies, Pietrantoni recently has given an important interpretation of the oculo-endocranial syndromes. He studied the circulatory relations between the pharynx and the sella turcica across the basic sphenoid and described four kinds of connections: (1) medial vascular connections across the basic sphenoid, (2) anterior lateral connections with the ophthalmic vein, (3) lateral intermediate connection direct with the cavernous sinus and (4) lateral posterior connection with the venous carotid plexus and thus indirectly with the cavernous sinus.

Of particular interest in the author's case is the knowledge of the lateral intermediate and direct connections with the cavernous sinus. By means of two lateral paired and symmetrical venous trunks, this is in relation with the pterygoid plexus, to which the posterior nasal veins are joined. The abducens nerve, having passed through the dura in relation to the apex of the petrous bone, is insinuated into the cavernous sinus, in which it runs externally to the internal carotid, being separated from the venous blood by the endothelial layer of the sinus. By compression of the nerve terminations in the

endonasal mucosa and perhaps by irritation of the sphenopalatine ganglion, the polypoid hypertrophy of the head of the middle turbinate could cause a strong venous congestion, which in turn would cause a compression and perhaps paralysis of the abducens. The same mechanism explains the frontal headache.

ACUTE PANSINUSITIS OF THE RIGHT SIDE WITH ORBITAL PHLEGMON AND EXOPHTHALMOS. ANTONINO PIAZZA MISSORICI, Rev. Oto-Neuro-Oftalmologica **4**:424 (July-Aug.) 1927.

The author reports the case of a boy, aged 16 years, who, with an attack of fever, complained of intense and deep pains in the right orbital region with swelling of the upper eyelid. As the fever and pain lasted and as the swelling increased, he came to the clinic. There the diagnosis of retrobulbar phlegmon was made, and several days later an incision was made about 1 cm. under the eyebrow. Pus was not obtained. On this day, the left cheek swelled so that mastication became difficult. The temperature still remained high but fell to normal in four days. Ten days after the palpebral incision was made, abundant purulent secretion came from it. On the same day, purulent secretion came from the corresponding side of the nose, with obstruction in the nose. Purulent ethmoiditis was diagnosed, and the boy returned to the clinic.

At that time the upper eyelid was so edematous that it completely covered the eye. The eyeball was normal, though somewhat proptosed. The inferior wall of the frontal sinus was probed to determine whether any fistula existed, but the wall was found intact and everywhere was covered with periosteum. However, an ethmoid fistula was found toward the deep part of the os planum. The diagnosis of necrotic ethmoiditis was made with certainty, but the presence of frontal sinusitis was not certain.

Operation was performed externally on the ethmoid, and an extensive pathologic change was found. The ethmoid labyrinth was entirely removed, and the sphenoid sinus was found to be involved by the suppurative process. The mucosa of the ethmoid cells in the sphenoidal sinus was greatly swollen, infiltrated and of a polypoid appearance.

At the end of the operation, a large opening was seen leading up to the frontal sinus. Trephination of the inferior wall of the superior internal angle of the orbit was done. As pus was found, the diagnosis of purulent frontal sinusitis was confirmed. A pure culture of *Streptococcus pyogenes* was obtained.

In the postoperative course, though the superior meatus of the nose was open, the inferior meatus was closed by congestion and swelling of the inferior turbinate. On account of this, disease of the maxillary sinuses was suspected. The maxillary sinus was punctured through the canine fossa, and it was found that there was an acute mucopurulent maxillary sinusitis. The postoperative course was uneventful, and in two weeks the sinusitis was healed.

The author feels that Citelli's method, which was used in this case for exploring and operating on the frontal and maxillary sinuses, represents the ideal means of procedure in this condition.

VAIL, Cincinnati.

Miscellaneous

LESIONS OF THE EYE FROM PURULENT MAXILLARY SINUSITIS AND LATENT ETHMOIDAL-SPHENOIDAL SINUSITIS. I. TOMMASI, Rev. Oto-Neuro-Oftalmologica **4**:428 (July-Aug.) 1927.

Tommasi reports the case of a woman, aged 57, who began to have pain in the left parietal frontal region and the infra-orbital region on the same side. The patient did not consider these disturbances important until she noticed that she did not see as well with the left eye as previously.

She complained of sharp spasmodic pains located in the second branch of the left trigeminal in the frontal, supra-orbital and temporal regions of the same

side which at times radiated to the vertex of the head and the occipital region and also to the temporal region on the opposite side. The movements of the eyeball were a little painful.

Rhinoscopic examination showed slight hypertrophy of the inferior turbinate and slight reddening of the middle turbinate in its posterior two-thirds. Pus was not found in the nose or in the nasopharynx. Tamponade with cotton introduced and left for five minutes in the middle nasal fossa and posterior olfactory fissure gave negative results. Transillumination of the frontal sinuses gave negative results. The left maxillary sinus was slightly more opaque than the right. Roentgen-ray examination did not reveal anything of importance.

General physical examination gave negative results.

Examination of the eyes showed a central scotoma (absolute) in the left visual field which extended to all the temporal field of that side. The fundus was normal. Because of the opthalmic report and the results of the objective endonasal examination, the diagnosis of a latent sinusitis of the sphenoidal sinus and the posterior ethmoid cells combined with a left maxillary sinusitis was made.

At operation a few days later, which consisted of resection of the middle turbinate, opening of the posterior ethmoid cells and the sphenoid sinuses with Halle's method, pus was not found anywhere. Though the bony walls of the ethmoid labyrinth had the appearance of healthy tissue, their mucosa was slightly thickened and congested. The maxillary sinus was operated on by the Krause method. On lavage of this sinus, a single flake of pus with some bloody material was obtained. Three days after the operation, the patient complained of periorbital and temporal pains but of less intensity than formerly. Two weeks after the operation, the patient's only complaint was a slight orbital pain. The visual field was somewhat more restricted than normal, but visual acuity was normal, and other alteration of the fundus oculi was not seen during ophthalmoscopic examination.

A Case of Acute Osteomyelitis of the Superior Maxilla with a Large Infra-Orbital Abscess in a Nursing Infant. Gino Merelli, Rev. Oto-Neuro-Oftalmologica **4**:435 (July-Aug.) 1927.

Merelli reports a case of an infant, aged 3⅓ months, who showed an enormous edema of the right lower eyelid of rapid onset. The mother said that for three days, without any known reason, the infant had refused food, vomited and had diarrhea. At the same time, the swelling was noticed.

General physical examination gave negative results, aside from an acute inflammation of the gastro-intestinal apparatus. External examination of the face showed that the right lower eyelid was reddened and edematous, so as to close the palpebral cleft completely. Palpation gave a sense of fluctuation, more especially toward the external part of the orbit. The right cheek, showed a swelling and redness corresponding with that of the upper part, though in less degree. Signs of acute inflammatory process were not seen in the nose. A marked painful swelling was found in the mouth; in the zone corresponding to the hard palate on the right side was a fistula from which came pus and in which a probe was passed for several centimeters against necrotic bony tissue on the right alveolar margin. A diagnosis was made of acute osteomyelitis of the superior maxilla.

Operation was done under local anesthesia through a deep incision in the gingivobuccal fold, with drainage and packing. The postoperative course was good, and the symptoms rapidly subsided. The fistula closed.

Merelli states that acute osteomyelitis of the superior maxilla in nursing infants and in the new-born is rare.

In discussing this case, Merelli states that the initial diagnosis is difficult, but that later the condition gives a characteristic triad: (1) swelling of the cheek of the alveolar margin and that side of the palate, (2) the presence of

superficial abscesses and fistula in characteristic points and (3) expulsion, also spontaneous, of tooth buds and bony sequestrums.

The author mentions the importance of differentiating this condition from phlegmon of the orbit, from purulent ophthalmia and from dacryocystitis. He says that the prognosis is always grave because the mortality is often serious, going from 30 to 50 per cent. Septicemia with purulent visceral localization is always a frequent complication. In the most benign forms, the process tends to become chronic and the suppuration continues for months.

Cases like the author's in which complete cure comes on quickly, are rare.

In regard to operative intervention, which must always be early, Broca distinguishes the cases in which fistulization has occurred and those in which it has not occurred. In the cases in which fistula exists, Broca advises cleaning up the abscess and taking away the sequestrums and granulations to give ample drainage. On the other hand, in any case in which fistulization has not occurred, the incisions usually made across the cheek are contraindicated on account of the deformities and those through the nasal cavity are also contraindicated because they are dangerous and difficult to perform in infants. The point of election in which to reach the various places of infection is the gingivobuccal sulcus. One of the most important principles of general operations in osteomyelitis is that of opening the various zones of infection, as much as possible.

VAIL, Cincinnati.

PREDISPOSITION IN ACUTE ANGINA. OSKAR BESELIN, Ztschr. f. Hals-, Nasen- u. Ohrenh. **19**:113 (Aug. 27) 1927.

Predisposition is probably more important in acquiring an acute angina than microbes. Autoinfection favors this view. The decrease of the power of resistance may be a "cold." Operation on the nose and vaccination are mentioned as predisposing factors. Little attention is paid to the fact that menstruation plays a part. Changes of the corpus luteum, of the endometrium, with the increase of glycogen in the endometrium, of the mamma and of the temperature have been noticed by van de Velde. The mucous membrane of the pharynx probably shows temporary changes. Freund saw hyperemia of the mucous membrane. Sendziak frequently observed follicular tonsillitis during menstruation; in some instances, it recurred during each menstruation. Gautier and Suchanek have reported similar experiences. Beselin studied 114 patients with simple, acute angina. Sixty-eight (60 per cent) did not show any relation between menstruation and angina during their stay in the hospital. In forty-six (40 per cent), the angina began in the premenstrual period, reached its climax shortly before menstruation or on the first day, and disappeared at the end of menstruation. If fever and pain in the throat continue beyond the last day of the menstrual period or if they even increase, a complication is present, most often an abscess. It has not been observed that angina has any influence on menstruation, except in women suffering from some disease of the genital organs. A woman suffering from menorrhagia bled for two weeks during the development of a peritonsillar abscess; after it was opened, the bleeding stopped. During the last days before the onset of menstruation and during menstruation, one should not operate in the region of the upper respiratory organs.

ESOPHAGOSCOPY AND GASTROSCOPY. RUDOLF GOEBELL, Ztschr. f. Hals-, Nasen- u. Ohrenh. **19**:116 (Aug. 27) 1927.

Sternberg's gastroscope should not be used. Goebell claims that Schindler's gastroscope is the only useful one. With the patient under the influence of cocaine, the dangers of introduction are greater, because a false route can be made easily. In some cases a perforation of the bronchus and lung and injuries of the diaphragm occurred. The patient should say "ah" in order to establish whether the tube has entered the trachea; this occurred twice in

the author's experience. The introduction of the instrument is a responsible act. The esophagus is in danger of perforation at three spots: (1) at the height of the larynx; (2) at the bifurcation and (3) immediately above the cardia.

Specht recommended that gastroscopy be preceded by esophagoscopy. Schindler's gastroscope fits exactly in Bruening's esophagoscope. After thorough anesthetizing, Bruening's esophagoscope is introduced, and the portion from the esophagus to the cardia is inspected thoroughly. Then the gastroscope is armed with the rubber attachment and introduced through the tube of the esophagoscope. However, even then an accident may occur. In one case, the author had introduced the gastroscope and observed the subcardial carcinoma of the stomach. An assistant was suddenly called away and moved in the wrong direction toward the feeding cord, thereby pushing the end of the eye-piece to the right and the distal end to the left. The lower end of the esophagus was injured, and an emphysema set in. The next morning, when the stomach was removed, a tear, 1 cm. in length, was found immediately above the cardia. The cardia and the lower end of the esophagus were resected, the jejunum was stitched to the esophagus and an entero-anastomosis was made. The patient died within a few hours. Necropsy showed the esophagus to be normal; a lesion could not be seen, and the stitches held perfectly. Goebell had an iron rod made which connects the examining table with the multostat in a manner which precludes an accident such as the one described.

DIAGNOSIS OF ZENKER'S DIVERTICULUM CAUSED BY PRESSURE. A. SEIFFERT, Ztschr. f. Hals-, Nasen- u. Ohrenh. **19**:118 (Aug. 27) 1927.

Most authors think that roentgen-ray examination is sufficient in the diagnosis of Zenker's diverticulum of the esophagus caused by pressure, or, better, of the hypopharynx. Seiffert does not consider this examination infallible. Charoul and Stierlin state that in a girl, aged 10 years, who suffered from disturbances while swallowing, the esophagus appeared strongly dilated and tortuous. The cardia presented a round, regular outline, typical of cardiospasm. At the level of the upper aperture of the thorax, a second pronounced dilatation had remained constant for almost four years. Operation proved that the esophagus was normal in the region of the neck. A spastic pseudodiverticulum was present. Kuhlenkampff mentions a similar case. Treplin reported a case of dilatation above an old structure, caused by a scar, which had been diagnosed as diverticulum by roentgen-ray examination. Other similar cases are mentioned in the literature. The author adds a new case. A surgeon, experienced in this type of cases, was misled by a roentgen-ray examination. Instead of the diverticulum, he found a dilatation in a carcinoma situated high in the esophagus, and he discontinued a needless operation. Recently, two cases were observed by the author in which the roentgenograms were similar. In one a large diverticulum was found, in the other a dilatation above a syphilitic stricture. In the latter case, the diagnosis "diverticulum" was made by an experienced colleague; yet the author avoided an error by esophagoscopy. Lateral exposures should be made for roentgenograms. The author suggests that the diverticulum be brought higher by lifting the head and causing the patient to swallow a contrast mass, and then by stopping at the height of the act of swallowing during exposure; the threshhold of the diverticulum can thus sometimes be demonstrated. In clear cases the roentgenogram may suffice, but the results cannot be compared with those obtained by esophagoscopy. Only esophagoscopy can give evidence of the shape, size and contents of the diverticulum, and of the character of the wall and of the threshhold, which is of great importance. The esophagoscope enters the diverticulum with certainty when one follows the technic given by Killian in his work "The Pulsion Diverticulum of the Hypopharynx and of the Mouth of the Esophagus." Eicken described this procedure in 1904. The diverticulum probe should be introduced into the esophagus and used as a guide for the esophagoscope.

AMBERG, Detroit.

Society Transactions

SECTION ON OTOLOGY AND LARYNGOLOGY OF THE COLLEGE OF PHYSICIANS OF PHILADELPHIA

Oct. 19, 1927

JAMES A. BABBITT, M.D., *Chairman*

DIFFICULTIES IN THE DIAGNOSIS OF LATERAL SINUS THROMBOSIS. Presented by DR. NATHAN P. STAUFFER.

Dr. Stauffer reported six cases of mastoid infection in which symptoms of sinus thrombosis developed subsequent to operation. Four of these cases were proved by operation to be the result of abscess and thrombosis of the lateral sinus. In one of these cases, the use of a spinal fluid manometer during the compression of the jugular veins gave positive proof of the existence of thrombosis. In another, the test was negative when a sinus thrombosis was present. The test was not used in four cases. Metastatic abscesses developed in one case. Two patients recovered without operation on the sinus. One of them had developed thrombophlebitis of the veins of the leg, which at first symptomatically simulated sinus thrombosis. The other was probably due to inflammation of the petrous portion of the temporal bone.

Dr. Stauffer concluded from his experience that the manometer test may be of great aid in the diagnosis of doubtful cases of thrombosis. In several cases, repeated transfusions of blood were used; with splendid results.

RHINORRHEA FOLLOWING RASPING OF THE FRONTAL SINUS. Presented by DR. E. W. COLLINS.

After two applications of a rasp to the left nasofrontal duct, the patient in the case reported developed profuse rhinorrhea. Although no chemical tests were made to establish with absolute certainty that the fluid from the nose was cerebrospinal, there seemed to be little doubt that the fluid was of that type. Complete recovery followed after eighteen days of rest in bed and palliative measures. Roentgen-ray examination of the skull showed wide vessel margins suggestive of increased intracranial pressure. It was the opinion of the author that at the time the rasp entered the frontal sinus, there was a herniation of the brain through an opening in the posterior wall of the frontal sinus.

ATYPICAL ESOPHAGEAL STRICTURE IN AN INFANT. Presented by DR. JAMES A. BABBITT.

A new-born infant began to vomit as soon as it began to nurse. This vomiting could not be relieved by atropine, gruel feedings or any of the usual palliative remedies. Partial atresia of the esophagus was diagnosed, and gastrostomy was considered. The intern on service, however, succeeded in introducing a small tube into the stomach by the nasal route. The baby did so well on nasal feedings that gastrostomy was not necessary. The diagnosis was confirmed by roentgenograms.

STUDIES IN VIENNA AND ZURICH. Presented by DR. ROBERT J. HUNTER.

Dr. Hunter spoke informally of his recent experiences in European clinics.

ATYPICAL NEURALGIA. Presented by DR. TEMPLE FAY.

This term applies to those types of pain about the face and head which cannot be classified as true trigeminal neuralgia. Many consider pain of this sort to be psychic, because an adequate explanation is not available. Dr. Fay feels certain that this type of pain does occur, and considers the following possible pathways of pain: seventh, ninth, tenth, eleventh, twelfth, cervical nerves and the sympathetic nerve. Although there is evidence that the facial nerve carries sensations of deep pressure, it is doubtful whether it can be responsible for the transmission of pain after the section of the sensory root of the fifth nerve. Two patients were operated on by Dr. Fay, and the results in these cases demonstrated that the ninth nerve does not carry pain fibers, and that its sensory function is devoted to the sense of taste and vasomotor responses secondary to the gustatory reflex. There is considerable evidence to show that the eleventh and twelfth nerves are purely motor. Dr. Fay then concludes that if facial pain exists after section of the sensory root of the trigeminal nerve, it must reach the cerebrum by the vagus, posterior cervical roots or the sympathetic roots. The speaker said that in order to make further eliminations in a case of facial pain resulting from carcinoma, he sectioned the sensory root of the fifth nerve, the intracranial root of the ninth, and the upper two posterior cervical roots. The patient still suffered from deep aching pain in the ear and pain in the face and neck on the side on which operation had been performed. Anesthesia was complete over that side of the head and neck, except in a small area within the concha of the ear which is supplied by the vagus nerve. Autopsy, fifteen months later, did not leave any doubt as to the complete destruction of the nerves mentioned. As a result of this case, the conclusion was advanced that pain must travel by either the sympathetic or the vagus nerve. In one case of carcinoma, the vagus nerve was sectioned intracranially. This section relieved all pain in the ear and throat and tenderness to deep pressure along the upper aspect of the neck. In another case, section of the hypoglossal nerve relieved pain behind the ear, in the lateral aspect of the neck and in the region of the tonsils. This was probably due to the vagus branch which the hypoglossal receives. In the case in which the vagus nerve was cut, the sympathetic chain had been interrupted below the superior cervical ganglion, leaving the vagus only as the pathway by which pain impulses could possibly reach the brain. It is possible that fibers associated with the vascular tree may be carried along the carotid and gain entrance to the cord via the cervical or thoracic segments. In order to prove or disprove this idea, observations, including sympathectomy, must be made. From the observations of Dr. Fay, he feels that these pain sensations of atypical neuralgia are probably carried by sympathetic fibers to the vagus and by that nerve trunk reach the stem of the brain.

DISCUSSION

DR. WILLIAM A. SEARS: Dr. Fay has called attention to a form of intractable neuralgia arising in suppurative otitis and at times associated with paralysis of the sixth nerve. This pain is atypical and is far removed from the suppuration in the temporal bone. Dr. Fay's suggestion of the transfer of a tympanic infection to the sheath of the carotid artery as it passes through its canal in the petrous portion of the temporal bone is possible. Its further extension along the sheath to the gasserian ganglion and sixth nerve seems equally possible. This mechanism probably serves to explain the pain sometimes present in jugular thrombosis.

Some years ago, Weisenberg reported a case of glossopharyngeal pain. Dandy has reported two cases in which the ninth nerve has been sectioned. I suggest that Dr. Fay, in closing, discuss the so-called glossopharyngeal neuralgia.

Hunt has studied the facial nerve with special reference to a sensory field in cases of otitic herpes zoster. He assumes this condition to be the result of involvement of the geniculate ganglion, which is similar to a posterior spinal root ganglion. The neuralgia associated with these cases is often severe. I have had six of these patients under my personal care. Four of them had complete facial palsy, and two had sixth nerve palsy associated with facial paralysis. Otalgias and mastoidalgias may arise from carious teeth and ulceration of the tongue or from pyriform fossa or the pharynx.

Although time is lacking to discuss in detail the Sluder syndrome, cocainization of the sphenopalative ganglion has given unquestioned relief in a large number of variously located pains.

Dr. Francis C. Grant: I have had a somewhat different experience from that of Dr. Fay. Many patients with facial neuralgia have not been relieved by section of the sensory root of the fifth nerve. Injections of the sphenopalatine ganglion have not been successful. Carotid stripping and section of the sympathetic nerve did not give relief. Of sixteen patients so treated, only one was relieved. The work of Dr. Fay is throwing more light on the subject, and selective nerve cutting in cases of carcinoma is entirely justifiable.

Directory of Ophthalmological and Otolaryngological Societies

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FIRST INTERNATIONAL OTO-RHINO-LARYNGOLOGICAL CONGRESS

President: Prof. E. Schmieglow, University of Copenhagen.
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NATIONAL

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Place: Hotel Statler, St. Louis. Time: Oct. 15-19, 1928.

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Secretary: Dr. Edwin N. Broyles, 1100 N. Charles St., Baltimore.
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Secretary: Dr. Austin A. Hayden, 25 E. Washington St., Chicago.
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Place: Winton Hotel. Time: Fourth Friday of each month.

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Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

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President: Dr. A. J. Lorie, 409 Commerce Bldg., Kansas City, Mo.
Secretary: Dr. A. E. Eubank, 636 Argyle Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May; the November, January and March meetings are devoted to clinical work.

NEW ORLEANS OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

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Secretary-Treasurer: Dr. Carl E. Granberry, Maison Blanche Bldg., New Orleans.
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Time: 8 p. m., third Thursday of each month from September to June.

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Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

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Place: Santa Barbara, Calif. Time: 1928.

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President: Dr. Ralph Butler, 2007 Chestnut St., Philadelphia.

Secretary: Dr. Herman B. Cohen, 13th & Spruce Sts., Philadelphia.

Place: College of Physicians. Time: 8:30 p. m., first Tuesday of each month from October to June.

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